[PRICE ONE SHILLING.]

BURTON'S

Modern Photography.

COMPRISING

PRACTICAL INSTRUCTIONS

IN WORKING

GELATINE DRY PLATES, PRINTING, &c.

(FORMERLY PUBLISHED AS THE

"ABC OF MODERN PHOTOGRAPHY."

By W. K. BURTON, C.E.

ELEVENTH EDITION.

LONDON:
CARTER & CO., 5, FURNIVAL STREET,
HOLBORN, E.C.

1894.

ESTABLISHED 1830.

GOLD MEDALS AND HIGHEST AWARDS AT ALL GREAT INTERNATIONAL EXHIBITIONS.

FOUR AWARDS AT WORLD'S FAIR, CHICAGO, 1893.

LISTS FREE.

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For Finest Work always employ

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These celebrated lenses are used by Photographers in every part of the world. Over 50,000 have been sold, and intending purchasers are invited to send for a Catalogue before making their selection.

ROSS-ZEISS

IMPROVED ANASTIGMATIC LENSES.
Manufactured by Ross & Co. in five different series for Studio and Outdoor work. Very fine lenses, carefully calculated, and finished in Ross & Co.'s well-known style. Prices have been revised, and several improvements introduced.

ROSS-GOERZ

NEW DOUBLE ANASTIGMATS.
These new lenses give splendid definition with full aperture, and embrace a wide angle of view. Manufactured by Ross & Co. in two Series, F/8 and F/15.

ROSS & CO., 111, New Bond St., LONDON, W.

The oldest Manufacturing Opticians in England.

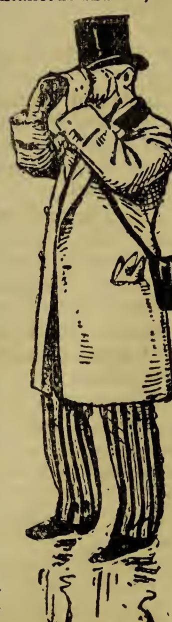
THE STEREOSCOPIC COMPANY'S

'BINOCULAR HAND-CAMERA'

Weighs, when loaded with 12 Plates or 30 Films, 19 ozs. only, but gives a picture measuring 7 by 5 inches.

THE 'BINOCULAR CAMERA' No. 1,

IS a complete photographic apparatus, containing, within the space occupied by a small field glass, a rapid rectilinear lens of the highest quality, an instantaneous shutter, and one dozen prepared dry plates or thirty films. There is also a finder or sighting glass, which permits of the exact size and appearance of the proposed picture being seen at the time of pressing the button. The plates are automatically and instantaneously changed.



The shutter is also arranged to give time exposures, so that, besides taking pictures of moving objects in a good light, the Camera can be used for home portraits in ordinary rooms, interiors, and out-door work in dull weather

One very important advantage possessed by this instrument over all other hand Cameras is found in the fact that in consequence of the 'Binocular' being held up to the eyes whilst the picture is being taken, the resulting photograph exactly represents the view as seen by a person of ordinary stature, and not as it would be seen by a child three feet high.

Although the negatives are necessarily of small dimensions, they are of such exquisite sharpness that they will bear enlarging to a considerable extent without loss of definition. This is most conveniently done by means of the special enlarging apparatus. The focus of the lens in this is permanently adjusted, and it is only necessary to place the negative in the frame at the one end, and the bromide paper or film in the other, and give a brief exposure to daylight. Thus it is actually as easy to make a print upon paper 7 × 5 inches as it would be to make one by contact in an ordinary printing frame. Nor is the enlarging apparatus itself a heavy or bulky instrument, measuring as it does only $8\frac{1}{2} \times 8\frac{1}{2} \times 6\frac{1}{4}$ inches, and weighing less than $3\frac{3}{4}$ lbs. It is, of course, understood that the enlarging apparatus is kept in the laboratory, the Camera only (weighing 19 ozs) being required in the field.

The small negatives answer admirably for printing lantern slides by contact, or prints from the same may be used for illustrating a diary or letter.

The 'BINOCULAR' CAMERA, No. 2,

Is constructed upon the same principles, but takes 18 plates $3\frac{1}{2} \times 2\frac{1}{2}$. It is a perfect instrument for producing negatives for printing lantern slides by contact.

PRICE OF 'BINOCULAR' CAMERAS.

	£	s.	d.
For plates	£5	5	0
,, films	5	5	0
* With Zeiss lens of *extreme rapidity* (*f*/6 3), enabling instantaneous pictures to be taken *without sunlight*	12	12	0
* No. 2 'Binocular' Camera, taking pictures $3\frac{1}{2} \times 2\frac{1}{2}$	10	10	0
* With Zeiss lens	17	17	0

* These Cameras are fitted with the improved shutter, with pneumatic time exposure attachment.

THE STEREOSCOPIC CO.,

106 & 108, REGENT STREET, W.,

And 54, CHEAPSIDE, LONDON.

F J McClure
Oct 7th 95

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ELEVENTH EDITION, REVISED AND ENLARGED.

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PREFACE TO THE ELEVENTH EDITION.

It is but a short time since this little book was nearly entirely re-written, the changes in photographic practice having made such a course desirable. The writer thought at that time that at least several years would elapse before anything farther in the way of revision than the correction of a few errors that had slipped into the ninth edition would be needed. So rapid, however, are the advances of photography in these days that something more is necessary, and the whole work has been thoroughly revised. Additions have been made, and also here and there alterations that have been suggested by practice.

Imperial University, Tokio, Japan.

PUBLISHERS' NOTE

ON THE

ELEVENTH EDITION.

THE fact of "BURTON'S MODERN PHOTOGRAPHY" being, perhaps, the most reliable and practically useful of the handbooks of photography, may reasonably lead the reader to expect much from the New Edition now placed in his hand; and certainly, in expecting the work to be brought well up to date, he will not be disappointed, in spite of the fact of the Author being resident in Japan.

The time which has elapsed between the sending of the manuscript of the book, and its production in print in London, has in no way made it uncurrent or behind the times, and the number of new or modified forms of anastigmatic lenses which have appeared during the past two months merely serves to emphasise the

position which Professor Burton takes upon pages 48 and 49: that for the greater part of the usual run of pictorial work it is doubtful whether the advantage of such forms compensates for the additional expense, although in the case of line work, or such special tasks as photo-grammetrical surveying, the advantage of the new instruments is undoubted.

As regards the newer developers, nothing need be said in extension of the remarks contained in Chapter XII.; in spite of all "advance," pyro-and-ammonia still leads the way, and is used regularly by the most successful workers. At any rate, the newer developers are of such doubtful advantage that Professor Burton is fully justified in the position he takes with regard to them; and even if he were now in London to revise the proofs of his book, it is doubtful whether he would add a word to Chapter XII.

THE PUBLISHERS.

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BURTON'S
MODERN PHOTOGRAPHY.

INTRODUCTION.

I wish at the outset to explain my reason for writing this little book, and the object which throughout I shall attempt to bear in mind.

After Archer brought out his collodion process, photography for the first time became a popular amusement with those who had a leaning to art or science, or both. The scientific interest and novelty attaching to the then comparatively new process, combined with a totally false idea of how easy it would be, by means of it, to make a "picture," attracted enormous numbers of those who had some spare time on their hands to take up the subject as amateurs. After a while, many of these found that their expectations were scarcely realised, and they found, too, to their surprise, that a mere transcript from nature was not necessarily a picture, but that as much art-culture, if not as much skill, is needed to produce such when the tools are the camera and lens, as when they are the pencil and brush. They found, also, that the skill required was greater than they had supposed—that, at least, a slight knowledge of chemistry and of physics was necessary, or endless troubles would arise.

The realisation of these facts greatly thinned the ranks of the amateurs. Another era has, however, now arisen in photography—the era of the dry gelatine process. The technical skill necessary to produce a photograph has been greatly reduced. The plate is now no longer prepared by bringing into contact, immediately before exposure, two fickle and uncertain chemical preparations—the "collodion" and the "bath"—but it may be purchased ready-made, will keep for a very long period, and may be exposed at any time. True, the artistic feeling is as necessary as ever; but that uncommon combination, a mind equally artistic and scientific, is needed to a less degree than before, and wider scope is given to the former capacity.

The consequence of this is, that the number of amateurs is now enormously on the increase. The man who has but a few summer days to spare may take the camera, and may work it with profit. There will probably be soon—if there is not now—an army of amateurs as great as there was twenty years ago. The ranks are continually being recruited, and greatly by those who have worked no other process before the gelatine one.*

Now I come to the object of this little work. How is the dry-plate aspirant, who takes up the gelatine process as his first, to gain the necessary information to enable him to practise the art? If he has a photographic friend—if his friend and he have coincident spare hours, and if his friend has the ability of conveying to others the knowledge which he himself possesses (an ability rarer than is generally supposed)—then the way whereby the would-be photographer is to gain his information is clear.†

* There are certainly more amateurs at the present time than there ever were before.

† There are now several institutions in which photography is excellently taught. If the beginner can attend one of these he certainly ought to do so.

In very many cases, however, the beginner has no such friend; then, where is he to turn? True, there are several excellent manuals published on the gelatine process, but these are quite unsuited for beginners; they presuppose a general knowledge of photography—at least, of the "wet process."* Then there are the directions contained in the boxes of plates which the tyro will purchase. They also are excellent in their way, but they are necessarily laconic, and they, as well as the manuals, are addressed to those who already are not unacquainted with photographic processes. They constantly refer to the collodion process as a standard, and they use technical language which is unintelligible to the beginner. Let any experienced photographer whose eye this may happen to meet try to cast his mind back to the times when he was tediously wading through the beginning of whatever was the first photographic process he worked. Can he remember when terms now so familiar to him, such as "detail in the shadows," "density in the high-lights," conveyed no idea to his mind? Perhaps he cannot; but such a time there certainly was for him, and now is for everyone who first attempts to solve the mystery of the language in which the modern dry-plate manuals and instructions in the plate-boxes are couched.

I know the case of many who have begun photography since gelatine became popular, and who, feeling the want I have attempted to explain—of anything to guide them to a direct knowledge of the working of dry plates—have familiarised

* It must be borne in mind that this was written substantially as it here stands in the beginning of 1882. I have left it with hardly any alteration, rather that any who read it may appreciate the huge changes that have taken place in the past ten years than for any other reason. What percentage, I wonder, even of professional photographers, would find instructions intelligent that constantly referred to the "wet process" as a thing familiar to them as a matter of course!

themselves with the more difficult wet process for the sole purpose of using it as a stepping-stone to the former. In speaking of the gelatine process as easier than the collodion, it must be understood that I do so on the assumption that the dry plates are purchased from the manufacturer, not made by the photographer himself. No beginner should attempt to make his own plates. He will find that he has quite enough to do to learn to work those that are made for him by others. In fact, I consider that the most experienced photographer who is wise will buy his plates, unless he takes an actual scientific interest in the manufacture. Dry plates can now be had so cheaply that he can scarcely expect to save money by making them. This, however, is a digression. To return to the subject. What I intend to do is to give instruction in the working of modern dry plates, addressed to the merest beginners. I shall use no technical terms, or only such as I have already explained, and shall assume no knowledge of any photographic process whatever.

My endeavour will be to give such instructions that those beginners who follow them carefully may, without any other assistance, after a little practice, be able to turn out, with a fair approach to certainty, technically perfect negatives on plates purchased from any trustworthy maker, and to make prints from the negatives, so as to enable them to complete their pictures. I shall avoid theory altogether; nor do I intend to enter into the question of art. All I propose to do is to teach the A B C of the subject—the purely technical. To the higher branches of photography—the artistic—the aspirant must be guided mostly by his natural gifts; but he will find much to assist him in many advanced books on photography. In fact, my desire is to produce a manual of photography *for beginners*, on the assumption that the gelatine process is now *the* photographic negative process of the day.

The last chapters will consist of concise instructions for the making of emulsions and coating of plates, so that the amateur who chooses, for pure love of so doing, to make his own plates, may do so. Here, again, I intend to avoid all theory, nor shall I enter at all deeply into the question of emulsion making, as the subject has been very fully treated in two different manuals published by Messrs. Piper and Carter.*

I intend to devote a chapter to the subject of lenses, and to give a few very simple rules whereby the beginner may gain some idea of the exposure that will be needed in different circumstances, and certain tables which will, for most cases, do away with the necessity for any calculation even of the simplest kind. It is common in manuals for beginners to say that knowledge of the length of exposure can only be gained by experience. This is partly true, but not entirely. Some idea may be given of how long the cap should be kept off the lens in certain circumstances, and this, I believe, will greatly assist the beginner. The writer remembers how, when he began the study of photography, with no assistance but such as he could get from the handbooks, he sought in vain for at least some faint clue to the length of exposure, and to the factors regulating it.

The subjects of enlarging and lantern slide making will be briefly treated.

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* "Photography with Emulsions," by Captain Abney; and "Modern Dry Plates," by Dr. J. M. Eder.

CHAPTER I.

SELECTION OF APPARATUS.

The first thing that the photographic beginner has to do, after he has made up his mind that he is going to take up the fascinating art, is to determine what size of "plate" he will work—that is to say, how large his pictures are to be. As a matter of course, he should begin work upon the smallest plates he can buy, as the first few results are sure to be far from perfect, and the cheaper the plates spoiled the better. This does not, however, bind him to the smallest size. All photographic cameras are made so that several different sized plates will fit them, and after the first difficulties are over, the tyro is sure to aspire to the production of something larger than the well-known "card" or carte-de-visite.

In considering size of plate to be worked, it must be borne in mind that the larger the plate the greater the weight to be carried into the field, the greater the difficulty of manipulation, and the heavier the expense at every turn. This being the case, I suggest, as a good size, that known as "half-plate"; that is, a plate measuring 6½ inches by 4¾ inches. This allows of pictures being taken of the popular cabinet size, and the apparatus necessary can very easily be manipulated in the field. A somewhat larger size—say 7½ by 5, which gives a landscape of very pretty size and shape—can easily be carried by an active man;

but I think that, at any rate, nothing greater than "whole-plate," or $8\frac{1}{2}$ inches by $6\frac{1}{2}$ inches, should be attempted at first. The smallest size of plates commonly offered for sale is the "quarter-plate," measuring $4\frac{1}{4}$ inches by $3\frac{1}{4}$ inches, and, as has been said, the beginner should confine himself to this size till he has become somewhat familiar with the different operations involved in the taking of a negative.

There is a natural tendency, at the present time, on account of advertisements of the "you pull the string, we do the rest" kind, for the beginner to take to hand-camera work. Now I am going to say nothing against the hand-camera, as I become daily more convinced of its usefulness, but I consider that hand-camera work is not for the beginner. To work a hand-camera needs all the skill that is necessary to work an ordinary camera, and some additional skill besides. If the photographer intend to confine himself to plates not larger than $3\frac{1}{4}$ by $4\frac{1}{4}$, or at the most 5 by 4, there is no harm in getting a hand-camera of one of the many kinds that can be used as an ordinary camera on a tripod. At first it should, of course, be used in this way.

As for those folks who go in for shooting with a hand-camera at all and sundry, not even attempting to gain any knowledge of photography, and then send the plates or films to be developed by a professional photographer, all I can say is that nothing in this book is written for them.

It may be a question whether glass or films should be worked. Films are made of excellent quality in the present day, and the subject of them is treated farther on, but, on the whole, I strongly recommend glass for the beginner.

Having decided the size, the next thing to consider is in what manner to purchase the apparatus; and here let me say emphatically that the only way in which to be *sure* of getting reliable photographic negatives is to go to a first-rate dealer and to purchase them new from him. There is a general idea

in the mind of the non-photographic public, probably gained from seeing numbers of old cameras and lenses exposed for sale in pawnshops and such like, that great bargains are to be made in second-hand photographic apparatus, and that the beginner may "pick up" what he wants very cheaply by a little looking about. There can be no greater mistake. The experienced photographer may pick up a very cheap article; but the man without technical knowledge is almost sure, if he attempt to do the like, to find on his hands goods that will be useless to him when he has somewhat advanced in his art.*

Having thus advised the reader where to purchase his apparatus, there still remains the question, "How? Is it advisable to go in for a complete set, or to buy each article separately?" The beginner will be best advised in this matter by the state of his funds. The "sets" made up by most of the chief photographic dealers are most excellent and complete; but the sum charged for them is greater than many are willing to lay out at once. These may buy at first only such articles as are absolutely necessary to begin with, and may add to their store from time to time as they think fit. I give a list of the articles most necessary for working quarter-plates, and afterwards shall say a word on such of them as seem to call for special description:—

A camera.
A lens.
A tripod stand.
A focussing cloth.
3 flat dishes or trays of porcelain or other material.
Graduated measure holding ½-ounce.
Ditto, ditto, 4 ounces.
A dozen gelatine ¼-plates.
A darkroom lamp.
A cheap chemical balance.

* This does not refer to those few respectable dealers who make the sale of second-hand photographic apparatus a special part of their business. The writer has found these reliable, and generally very accommodating in effecting exchange of apparatus, and so forth.

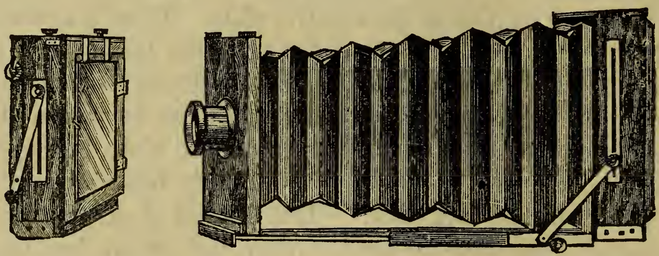
The Camera.

The general form of the photographic camera must be familiar to all. It consists essentially of a box, at one end of which is held a sensitive plate, whilst at the other is held a lens. An inverted image of any bright object which may be opposite the lens is thrown by it on to the sensitive plate. There is a means of adjusting the distance between the plate and the lens, or, as it is commonly expressed, of focussing. Every camera has, besides this, a piece of ground glass, which can be put in the exact place to be afterwards occupied by the plate, and upon which the image can be seen so as to facilitate focussing. It is also fitted with a "dark slide." This is a sort of case in which a sensitive plate may be fixed. After the camera has been focussed, the dark slide is placed in the position before occupied by the ground glass, which latter is removable. The "shutter," or sliding door of the dark slide, is then removed, and, on taking the cap off the lens, the image falls on the plate. As many dark slides as are wished may go with a camera, and thus a number of plates may be carried into the field. Slides are constructed to hold two plates each, and are called "double dark slides." These are by far the best and most convenient to use for dry plates. Three slides are a common number to go with a camera. This enables half a dozen plates to be carried out. Each dark slide should be fitted with a set of "carriers." These enable plates smaller than the largest size for which it is constructed to be placed in it.*

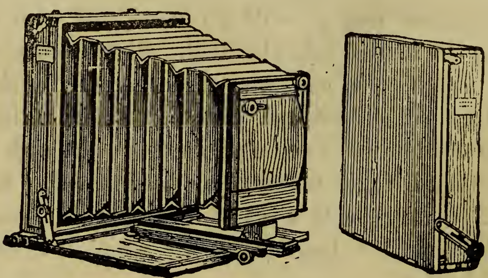
All modern cameras for use in the field are made so that they can fold up into small compass for ease in carrying, and have "bellows bodies," that is to say, can be drawn out and in like a

* See chapter which treats of sensitive films to take the place of glass plates.

concertina. We illustrate three of the best modern forms of camera, showing in each the camera as in use, and as folded down for transportation. In purchasing a camera, the photographer should get one which will open to a considerable distance—if possible, to as much as twice or three times the length

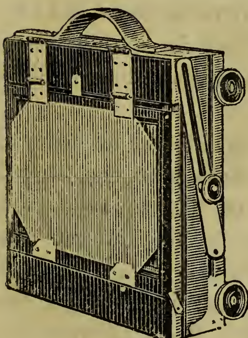


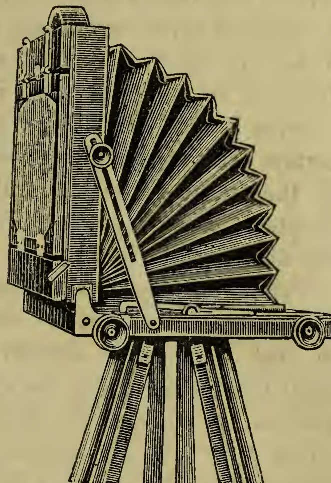
of the largest sized plate which it will work. In some part of his career the amateur is sure to aspire to the taking of portraits. His attempts in this direction are likely to be failures, and to

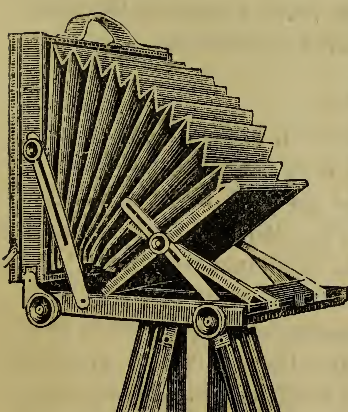


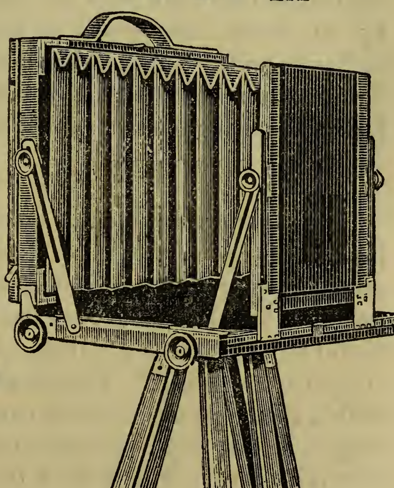
cause great pain to his friends; but nothing is surer than that the portrait fit will attack him. When it comes to this, he will find a camera that opens to a considerable length a great advantage. Even apart from the matter of portraits, a camera opening to a considerable length is desirable, as it is now becoming a generally recognised fact that more artistic pictures are got with

lenses of comparatively long focus than with those of very short focus.*









* See chapter on Photographic Optics.

There are various adjustments attached to modern cameras which, although of little use in the hands of the beginner, will be found of great convenience to him when he is more advanced. These are chiefly a vertical and horizontal adjustment of the front on to which the lens is screwed, and what is called a "swing back." This latter provides a means of varying to a certain extent the angle between the sensitive plate and the axis of the lens. Its action will be described in a subsequent chapter. A leather case, in which the camera and dark slides can fit, should be provided.

Various attempts have been made to obviate the necessity of having separate dark slides, and cameras have been constructed so that they either contain a supply of plates themselves, appliances being added to enable these to be brought into position, or so that the plates are contained in a box from which they may be transmitted to the camera without the intervention of more than one dark-slide. Some of these are by no means unsuccessful in practice, but, on the whole, I incline to prefer double dark slides to any of them; at any rate, for sizes over $6\frac{1}{2}$ by $4\frac{3}{4}$. For very small plates, on the other hand, "changing boxes" are a decided convenience.

The Lens.

Next in importance to the camera—if, in fact, it is not more important—comes the LENS. As it is intended to devote a special chapter to lenses, I shall not go much into the question just now, but shall merely say that, for all-round work, the most useful forms of lenses are those sold as "rapid rectilinear," and "rapid symmetrical." These lenses were, until recently, made with a maximum aperture not exceeding one-eighth of the focal length. Now some opticians make them with an aperture between a fifth and a sixth of the focal length. These extra-rapid lenses will be found very useful for sizes up to and

including $6\frac{1}{2}$ by $6\frac{3}{4}$, or even $7\frac{1}{2}$ by 5, especially making excellent portrait lenses; but for larger sizes they are not to be recommended, at least, to the photographer who is confined to the use of one lens, as, for certain reasons that it is unnecessary to describe here, advantage can seldom be taken of the extra large aperture in the case of the larger lenses. A cheaper and very useful lens, though not so rapid as that just described, is one of the "single achromatic" lenses of modern design. The "wide-angle" landscape lens mentioned in former editions of this book is an excellent one for special work, but is not to be recommended for all-round work unless of a focal length to cover a plate several sizes larger than that actually used with it. Indeed, whatever form of lens be adopted, the focal length should be from $1\frac{1}{3}$ to $1\frac{1}{2}$ the length of the largest plate to be worked, whatever the catalogue may say about the covering power of the lens. (See chapter on Lenses.)

The tripod-stand calls for little special remark. Its general form is known to all. In stands of modern construction each leg folds into two, or sometimes into three, so as to make the whole more portable; and in some cases each leg has a sliding adjustment. The chief requirements of the camera-stand are that it should be light, be easy to fit up and take down, and should be rigid when fixed up.

The focussing cloth is intended to cover the head and ground glass, thereby shutting out extraneous light, and making it possible to see the image given by the lens sufficiently distinctly to adjust the focus. It should be about four feet square for small sized cameras. Velvet or velveteen is the best material to use, but any black and opaque cloth will do.

The flat dishes or trays—or, as they are sometimes called, flat baths—are for use in the operation of developing, fixing, &c., to be described in a future chapter. Such dishes, made of so-called porcelain, can be had for a few pence each and upwards,

and I recommend that these be purchased for quarter-plate work. When the photographer advances to larger sizes, he may indulge in the more expensive and more convenient dishes made of ebonite or other light material.

The dry plates can be bought from any photographic dealer. They are extensively advertised in the photographic periodicals; but I cannot take upon myself to recommend one make in preference to another. I have found almost all excellent, the cheap as well as the more expensive. It will be found advisable, at first, to use those sold under such names as "ordinary," "landscape," and to avoid the very rapid makes.

The dark-room lamp will be described when we come to the chapter on the "Dark-Room."

The most convenient balance for photographic use is such a one as druggists weigh out their chemicals in; but a small pair of scales without stand, such as is sold for about half-a-crown, will do well. For practical photography, weighing apparatus of great delicacy is by no means necessary. A set of grain and drachm weights are needed. The system known as "Apothecaries' weight" has been adopted throughout this book, because it is that most generally used for practical chemical and photographic work in this country. But it is unnecessary to say that the French decimal system is vastly superior. In the case of all formulæ, a corresponding formula in French decimal measures and weights is given in a foot note in the present edition. It has not been attempted to make these correspond exactly with the English weights and measures. It would involve many odd figures, and often many decimals, to do so; and, as photographic formulæ are generally very elastic, it is considered that it will be of more convenience in practice to give formulæ that are practically correct, and that are in round figures, than to exactly reproduce the proportions given in the English formulæ.

CHAPTER II.

CHEMICALS.

After the photographer has provided himself with the necessary apparatus and plates, his first consideration must be the purchase of the chemicals which he will need to convert his plates into negatives. A list is given of these, stating after each about the quantity I think it desirable that he should possess himself of at first. Afterwards are given a few words describing the general properties of each substance, but not entering into the chemical composition. Each chemical, whether liquid or solid, should be kept in a bottle, which should have the name distinctly labelled upon it, if possible, in print.

The chemicals needed are as follows:—

Pyrogallic acid	1	ounce
Ammonia of specific gravity ·880	3 or 4	ounces
Carbonate of potash	1	pound
Sulphite of soda	1	,,
Bromide of potassium	1	ounce
Citric acid	1	,,
Hyposulphite of soda	1	pound
Alum	½	,,
Methylated spirit	½	pint
Bichloride of mercury	1	ounce
Negative varnish	A few ounces	

A couple of books of test papers, one of blue litmus and one of red litmus.

Pyrogallic Acid is a white, feathery, and extremely light body. It is exceedingly soluble in water. It is a powerful absorber of oxygen, especially when alkaline. When a solution of it has absorbed oxygen it turns brown.

The *Ammonia* used in photography is the strongest solution of ammonia gas in which it is possible to make water at atmospheric pressure, and has, or is supposed to have, a specific gravity of ·88. Ammonia is the well-known hartshorn. It is a transparent and colourless fluid. It is powerfully alkaline. When the stock has been purchased, it is advisable to pour it at once into a bottle holding exactly double the amount of the ammonia, and to fill up the bottle with water. If this is not done, the stopper of the smaller bottle may be blown out by the pressure of the liberated ammonia gas when the weather is warm. This will destroy the whole, as, on exposure to air, the liquor ammonia rapidly becomes weaker, because the ammonia gas escapes.*

Carbonate of Potash is in the form of a heavy white powder, or of very small white crystals. It is deliquescent, and the bottle containing it should be kept well corked or stoppered,

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* Great caution should be used in opening bottles of this very concentrated ammonia. Twice it has happened with the writer that, opening a bottle of ·88 ammonia, there has been no motion for a second or two, after which violent ebullition has taken place, and nearly the whole of the contents of the bottle have been blown out with such force as to strike the ceiling of the room. In these cases no harm resulted farther than, in one of them, the bottle being a "Winchester quart," containing half a gallon, the inmates of the whole house had to make for the open air, and could not return for some half an hour or so. The writer has, however, just heard of a case in which the ammonia was driven straight into the face of an amateur photographer, who thereby totally lost the use of one eye.

otherwise the potash is liable to absorb much moisture. It is very readily soluble in water.

Sulphite of Soda is in the form of irregular white crystals. It is liable, on exposure to the air, to become oxidised into sulphate of soda, in which form it is useless for the purpose for which it is intended in photography. The bottle containing it should, therefore, be kept tightly corked or stoppered. The crystals should be clear and transparent. If they are covered with a white powdery deposit it is likely that the sulphite has been partly oxidised. Sulphite of soda is very readily soluble in water.

Bromide of Potassium is usually found in the form of fairly large crystals of regular structure. It is very readily soluble in water.

Citric Acid is met with either as clear, colourless crystals, or as a powder. It is soluble in water.

Hyposulphite of Soda is a clear, colourless, crystalline body, slightly deliquescent. It is readily soluble in water.

The Alum used may be the ordinary alum sold by grocers. As it is intended to be dissolved in water, it should be bought in the form of a powder. It does not dissolve in very large quantities in cold water, and dissolves somewhat slowly. It dissolves readily in hot water when it is in the form of powder.

Methylated Spirit calls for no particular notice, as it is well known to all. For all purposes where "methylated spirit" is mentioned here, the new spirit containing a small quantity of mineral oil will do. Where "alcohol" is mentioned, it is to be understood that "methylated spirit" must not be used. The liquid sold as "finish" is not suitable for photographic purposes.

Bichloride of Mercury is a whitish crystalline substance. It is sparingly soluble in water, and is an active poison. It is commonly known as corrosive sublimate.

Negative Varnish in appearance is very like the ordinary spirit varnish used for varnishing wood, but generally differs from it in the resin used in its manufacture. It can be bought from any photographic dealer. That sold as "dry plate negative varnish" is the most suitable.

The Test-Papers are for discovering whether a liquid, such as a solution of any salt, is neutral, acid, or alkaline. To use them, we proceed as follows:—Suppose we have a solution of whose condition as regards acidity or alkalinity we are ignorant. A small piece of the blue litmus paper is dipped into the solution. If the paper change its colour to red at once, or after a short time, the solution is acid; if no change in its colour take place, the solution is either neutral or alkaline. In this latter case, a piece of the red litmus paper is dipped into it; we now know the exact condition of the liquid. If the red litmus become blue, the solution is alkaline; if no change take place, it is neutral.

I have now enumerated and shortly described the necessary chemicals for *beginning* photography, and shall give instructions for mixing a few of what are called "stock solutions." These are solutions which may be kept for some time, and that the photographer should have by him. The ones described are those to be used in the first lesson in development.

Stock Solution.

No. 1 bottle to be labelled "*Ten per cent. Solution of Pyrogallic Acid,*" in large letters, so that it may be read in a dull light. We take four ounces of sulphite of soda, and one dram of citric acid, and add warm water till the whole measure about nine ounces, stirring till the crystals are quite dissolved. We then pour the solution over the pyrogallic acid in a fresh one-ounce bottle. The pyro will dissolve instantly. We then

make the whole quantity up to ten ounces.* This may be looked upon as a ten per cent. solution of pyrogallic acid merely, the only function of the other chemicals being to prevent the spontaneous oxidation of this substance, and the consequent deterioration of the solution.

No. 2. *Ten per cent. Solution of Carbonate of Potash.*—This is made simply by placing one ounce of carbonate of potash in a measure, filling up to ten ounces with cold water, and stirring with a glass rod till the salt is melted.†

No. 3. *Alum Solution.*—Three or four ounces of the alum are placed in a pint bottle. This is filled up with warm water. The whole of the alum will probably dissolve, but some of it will be thrown down again as crystals when the solution becomes cold. As long as these last, more water may be added from time to time, as the solution is used. When they are all dissolved, more alum must be added.

No. 4. *Fixing Solution.*—Five ounces of hyposulphite of soda or "hypo" are placed in a pint bottle, which is filled up with warm water, and shaken till the crystals are dissolved.

Common tap-water may be used for all these solutions, which, stated briefly, are as follows:—

No. 1. Ten per cent. solution of pyrogallic acid.
No. 2. Ten per cent. solution of carbonate of potash.
No. 3. Saturated solution of alum.
No. 4. Twenty-five per cent. solution of "hypo."

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* Sulphite of soda	... 120	grammes
Citric acid	... 4	,,
Pyrogallic acid	... 30	,,
Water enough to make up to ...	... 300	c.c.

† Carbonate of potash	... 50	grammes
Water sufficient to make up to ...	... 500	c.c.

CHAPTER III.

THE DARK ROOM.

The reader will understand that the plates he is about to work with are of the most "exalted sensitiveness"; that is to say, a very small amount of light allowed to act on them will produce a change which may be made visible. It must be explained, however, that only certain rays of light have the power of making the change here mentioned. All readers who have a little knowledge of physical science know that white light is in reality a combination of light of all the beautiful colours we see in the rainbow, and that if we pass a ray of white light through a prism, it will be broken up into all these colours. The order of them is:—Violet, indigo, blue, green, yellow, orange, and red. Those at the beginning of the list are called rays of high refrangibility; those at the end, rays of low refrangibility. Now, it is a curious fact that the photographic change which is worked on the ordinary sensitive plate is worked almost entirely by the rays of high refrangibility, principally by the violet and blue, and certain invisible rays even more refrangible than these, which are said to be "actinic"; whilst the red, which is said to be "non-actinic," has no appreciable effect. Were it not for this peculiar fact, photography would be almost impossible, because we could find no light in which we could manipulate our plates without

their being affected, and consequently destroyed. As it is, however, we only need to secure some place illuminated by those rays that have very little photographic action, and we can work with tolerable freedom. In other words, we want a room lighted with only red, orange, or yellow light in which to work.

Until recently it was supposed that the modern sensitive dry plates could not be worked but in the deepest of ruby light. Thanks, however, to Mr. W. E. Debenham, we now know that it is quite as safe to work in orange, or even yellow light, as in ruby; that, indeed, if the proper shade of yellow be got, it is probable that more visual light may safely be admitted than when the colour is ruby.

Photographers give a room lighted with only non-actinic light the name of "dark-room," although the term is a misnomer. On the "dark-room," then, I propose to give what hints I consider necessary for the beginner.

It is scarcely to be expected that the young amateur, taking up the subject of photography for the first time, will be able to obtain the exclusive use of a room of considerable size to convert into a dark-room; he will probably have to put up with some temporary arrangement; nor is it at all necessary, even when he advances considerably, that he should have a permanent dark-room, unless he intends to make his own plates. Any room or closet from which all rays of white light can be shut off may be converted into a dark-room, in which plates may be changed and developed. If a room having a sink and water-tap—if, say, the pantry—can be "annexed" for the time being, the trouble will be greatly reduced; but it is quite possible to make shift with a pail for a sink, and a water-jug instead of a tap.

I have said that it is necessary to shut out entirely all daylight. This pre-supposes the use of artificial light for illumin-

ating the apartment with the necessary red or non-actinic light. I think that until such time as the student sees his way to fitting up a permanent dark-room, he will find it best to work with artificial light. Indeed, many, the writer amongst others, who have permanent dark-rooms, prefer to use artificial light, even in the daytime, because it varies less than daylight.

Lamps constructed especially for the purpose of giving "safe light" are sold by all dealers in photographic apparatus. These use either gas, oil, or candles, and all consist of an arrangement whereby the air necessary to support combustion is introduced by passages which will not allow white light to find its way out, the colour of the light being modified by funnels or globes of ruby glass, or shades of ruby, orange, or yellow paper or cloth. The gas and oil lamps are much to be preferred to the candle arrangements, as with the former it is possible to raise or lower the light at will.

All, then, that the photographer has to do, is to find some small room or closet, which he can make quite dark, in which he can have a plain deal table to work upon, and to purchase a "dark-room lamp" from a photographic apparatus dealer. The description of dark rooms will not, however, be complete unless something is said about the fitting up of a permanent photographic room, in which all the operations, including the manufacture of the plates, may be conducted. On page 25 is given a sketch of such a room; but before giving some details about it, I think it well to say a word or two on the actual amount of light admissible to the dark room. If the plates that we have to use were absolutely insensitive to red, orange, and yellow light, and if there were no difficulty in selecting coloured mediums that passed only the light of one part of the spectrum, there would be no difficulty in arranging a so-called "dark room" that might, nevertheless, have an indefinite amount

of a certain coloured light; but the two facts come in, that modern dry plates are more or less sensitive to light of all parts of the spectrum, so that, even if we could select a light representing only a very limited part of the spectrum, we would find it practically impossible to have an absolutely safe light; but there is also the almost insurmountable difficulty of getting a light that represents only a very limited part of the spectrum. The outcome of all this is, that there is no such thing as an absolutely safe light, and that we should, in all work with dry plates, use no more light than is necessary to enable us thoroughly to see what we are doing. It is quite possible, however, to have a practically safe light that may be quite comfortable to work by *when our eyes are accustomed to it*, but I would point out to all who are working in the dark-room for the first time, that there is an enormous difference in the estimate that we make of the strength of a light, according to whether we come on it first from a brighter or a less bright light. To give an example: If we come from brilliant sunlight into a dark-room that is properly lighted, we see nothing but the lamp or lamps, and these but dimly. If, however, we come into the same room, after having been in the dark, of an evening, for an hour or two, it will appear so bright that one can scarcely believe that it is the same room as was seen before lighted in the same way; every article in it is distinctly visible, and it may even be possible to read a newspaper in it. This is partly due to the contraction of the retina in the bright light, and the expansion in dark, but is much more due to the great loss of sensitiveness that the retina suffers in very bright light. After coming from bright sunlight into a dark-room, it takes from a quarter of an hour to twenty minutes for the full sensitiveness of the retina to be regained, and any estimate of the light used for development up to that time is likely to be an under-estimate. Probably few people have gone oftener in and

out of dark-rooms than the writer during the past ten years, yet the extraordinary apparent increase in the light of a dark-room that takes place within about a quarter of an hour of entering it from a very bright light never ceases to astonish him, and even yet he can sometimes scarcely believe that the increase is only apparent. It will be understood then that, if we select the right colour, we can have enough light to be able to see quite easily at those times when the sensitiveness of the retina is at the maximum, but that no light can be safe that will enable us to see at all easily immediately after coming from a very bright light into the dark-room.

A sketch of a dark-room suitable to an amateur is given on the next page.

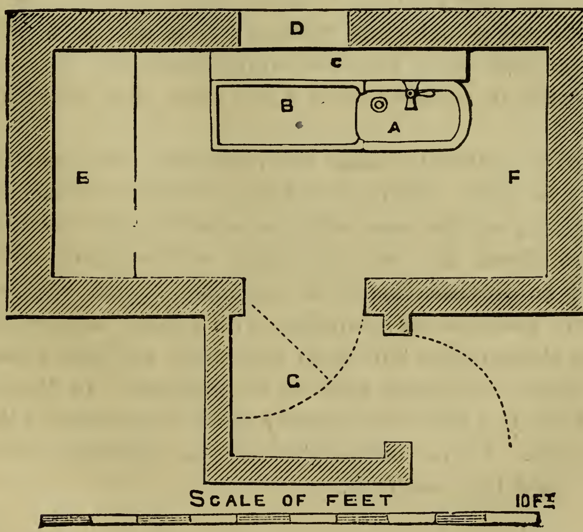
D is a window whereby the necessary light is introduced, unless it is decided to use artificial light at all times, in which case the place of the window is taken by a "dark-room lamp," which should have as large a surface for diffusing the light as possible. The window should be about two feet long, by one foot six inches high. It may be glazed in any of several ways.

The following will be found to give a good, and, at the same time, a safe (as qualified above) light. A sheet of orange stained glass is used, and between this and the operator a sheet of "canary medium"—a light yellow paper—is fixed. A movable screen of orange paper should be so arranged that it may be brought down to cover the window when the light is very intense, or when the process of plate manufacture goes on. It greatly facilitates working if a movable shade be so arranged that it may be brought between the window and the eyes of the operator whilst still letting the light fall on the plate, and permitting the operator to see the latter.

A is a sink made of glazed stoneware. The top edge should be about two feet six inches, or two feet eight inches, above the floor.

B is the operating table. It should be covered with sheet lead, should have a very narrow and low ridge round all the sides except that next to the sink, should have a very slight inclination in that direction, and should have the sheet lead "dressed" over the edge of the sink, so that all spillings may find their way into the last-mentioned.

C is a narrow shelf about four inches above the level of the table and sink, and extending along the whole length of both of them. On it may be placed the lamp when artificial light is used, as when working at night, and the bottles of solutions



actually used for the development. The lower edge of the window should be an inch or two above this shelf. There should be a shelf about six inches below the operating-table, on which the flat developing dishes may be kept.

E is a table on which the levelling slab may be placed when the manufacture of plates is begun. Above it—or, in fact

along all available space of the walls—shelves may be fixed for carrying bottles, &c.

A space is reserved at F for the drying-cupboard, used in manufacturing plates. Above this latter, and with its lowest edge about three feet higher than the floor, should be fixed an ordinary cupboard, with a door closing light-tight. In this may be placed plates or anything sensitive to light, which would be destroyed if left about; for, as has already been explained, any kind of light will in time act upon the sensitive plate.

G is an arrangement of double doors whereby the photographer may go out or in without letting any light enter. If there be not space for this arrangement, one door may be used, with an opaque curtain a foot wider than this door hung inside it.

Provision must be made for ventilating the room without letting in light. There should be at least one common gas jet for lighting up the room when no sensitive plates are about, so that solutions, &c., may be mixed with comfort, and there should be provision made for attaching several rubber tubes with the gas-pipes for connecting with Bunsen burners, &c.

The photographer will in all probability not *build* a room, but will adapt one already built to his purposes. In this case he will have to exert his ingenuity to allot his space to the best advantage. I have enumerated all the appliances for which room ought to be reserved.

CHAPTER IV.

EXPOSURE OF THE PLATE.

Before giving instructions in the actual manipulations of developing a plate, it is right to define the terms negative, exposure, and development.

A negative may be said to be a pictorial representation which, on looking through it at a bright light, shows all the shades, which are seen in any represented object, reversed. Thus, when we look through a negative of a landscape, holding it between us and (say) a gas-light, we see the sky and all objects which are in reality brightest, represented as black; whilst the darker parts of the landscape are represented by the bare and transparent glass. If the negative be a portrait, we see the face black, looking like a negro's, whilst a black coat looks white, and so on. The negative is produced by the action of light in the camera, the places where the light has acted most strongly being turned black. The time during which it is necessary for the light to act on the plate to produce the required effect is called the exposure. Now, it has been explained that the light acts upon the plate and darkens certain portions of it, but it must be understood that this action is not at first visible. A marvellously short exposure is sufficient to impress on a plate all the details of a landscape in such a manner that, by afterwards acting upon the plate with certain chemicals,

these details may be made visible. This operation is called development, and consists essentially in the increasing of the strength of a negative so faint as to be invisible to the eye, till it becomes as vigorous as we wish. Anyone, however, unconversant with photographic operations, will see that when once we have obtained a reverse picture, such as we have described, we have nothing to do but to place this in contact with a sensitive film, and allow light to act through the negative, when we shall get a picture with its shades true to nature. The latter process is usually gone through with sensitive paper, and is termed printing.

Upon correct exposure and development, nine-tenths of the technical success of negative-making depends; and when once the student has thoroughly mastered the relation of the one to the other, half the battle will be over. He cannot do so without practice; but I hope to give him such assistance in explaining the matter as may lead him to the desired end as quickly as possible.

Let the beginner select an object upon which he will make his first attempt. If he can resist the temptation to try a portrait, so much the better. A brightly-lighted landscape, with strong contrasts of light and shade, is the best; it need not be picturesque. A suitable view can generally be got out of some window, or a very suitable subject is a bust or statue placed either in a well-lighted room or out of doors. We shall suppose, in the present instance, that the landscape is selected. The camera should point neither towards nor away from the sun. If the sun shine direct into the lens, the plate would be destroyed; if the sun be directly at the back of the camera, the picture will look "flat."

Before beginning operations, I wish to explain what is the meaning of correct exposure. Let the student look attentively at the view which he has selected to make his first attempt

upon. He will see that, apart from the various colours represented, there is a very great variety of light and shade. He knows that this range is brought about by the fact that different objects reflect different amounts of light to his eye. Probably the sky will reflect the most light, and going through the whole range from this, he will see that there are a few little bits of the landscape that appear absolutely black. They do reflect some light, but it is so little that, by contrast with the brighter objects, they appear to reflect none. Now let the student consider the process that goes on during exposure. He knows that when he has his camera with a dry plate in position, and when he has removed the cap of the lens, a perfect picture of the landscape, with all the shades of light, will be thrown on the sensitive film, and that the light will be acting upon it. It is evident the brighter parts of the picture will first take effect, and afterwards the darker, until the exposure has been prolonged to such a period that all the shades of light, except those which, as we explained, appear in the landscape absolutely black, will have impressed themselves. At this point the correct exposure has been given. Had a shorter time been allowed, some of the darker shades—or, as they are technically called, the detail in the shadows—would have failed to impress themselves, and the resulting negative would have been said to be under-exposed. On the other hand, had the exposure been prolonged, the light emanating from the apparently black parts of the landscape would have impressed the plate, which would eventually appear to be darkened all over, and would be said to be fogged from over-exposure. It is said of a correctly-exposed negative, that it shows all the details in the shadows without being fogged; if it be correctly developed, there is added to this a just gradation of density.

Now we pass on to the practical exposure of a plate, and I shall endeavour to show the student how he can tell, by the

behaviour of the plate during development, whether he has hit the much-desired correct exposure or not.

He will need to light his dark-room lamp, and to get by him the three flat dishes, the two measuring glasses, all the stock solutions for the mixing of which directions were given in a former chapter, and his box of dry plates.

Now he places his camera in position, opposite the view to be photographed ; he removes the cap from the lens, and places his head under the focussing-cloth. He removes all stops from the lens, if it has movable stops, or, if the stops be rotary, turns them till the largest one is in use. This will make the image on the ground glass comparatively bright, and, by turning the focussing-screw first one way, then the other, he will easily find in what position the image is the sharpest. When he has discovered this, he places the smallest stop in the lens. I say the smallest stop, not because it is necessarily the best for the picture which he is going to take, but because it will enable him to give a comparatively long exposure, which is a convenience, at first at least.

Having his camera fixed and focussed, let him place the cap on the lens once more, and retire to the dark room to fill a slide.

When once here, he places the dark slide open in front of the lamp. Now he lowers the light till there is only just enough to enable him to see distinctly.* He opens his plate-box and takes out two plates—two glasses must be placed in the dark slide at once, but one may be a "dummy" if he happen to have but one dry plate ; that is, either a clean plate of glass or a spoilt negative. In placing the plates in the slide, he must be very careful that in each case the side of the plate which appears

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* Note what was said in the last chapter about the effect of coming from a bright light into the dark room. It will generally be found best to place the plate in the slide *before* going out to focus.

dull, on account of its having the sensitive film on it, is placed towards the outside. Now, having closed his dark slide and wrapped his plates up again, the photographer returns to the camera. He should carry the dark slide under the focussing cloth, for additional security against light ; and in placing the slide in the camera and during exposure should keep the whole apparatus, with the exception of the lens, under the cloth for the same reason. He removes the focussing screen, and places the dark slide in the position occupied by it, keeping the side marked "1" towards the lens. He now withdraws the sliding door, which is the only thing intervening between the lens and the sensitive plate. He takes his watch in his hand, and removes the cap from the lens for (say) five seconds, replaces it, slides in the shutter of the dark slide, and carries the latter off to the dark room. I have supposed any of the usual view lenses to be used, the landscape to be brightly lighted, the time of year to be spring or summer, the time of day morning or noon, and the plates to be of "ordinary" rapidity.

CHAPTER V.

FIRST LESSON IN DEVELOPMENT.

In the last chapter the photographer was left at that stage where he had accomplished the exposure of a plate, and was about to begin the development. It should be explained that the developer with which he is going to make his first experiment is that known as "alkaline pyro."

In the earlier editions of this book, I advised the beginner to make his first experiments in development with "ferrous oxalate," on account of its comparative simplicity. I now, however, consider that, on account of the introduction of sulphite of soda and alkaline carbonates in connection with pyrogallic acid, what is known as the "alkaline developer" is the simplest of any. A description of ferrous oxalate development is given in a future chapter.

The photographer has now, let us suppose, returned to his dark room. He may lay his dark slide, still wrapped in the cloth, on a shelf, and, turning up the white light, make the following preparations. He lays the three flat dishes in a row along the front edge of the table, the one to the left opposite the red light, the others to the right of this one. I shall call the dishes Nos. 1, 2, and 3, beginning at the left. Into No. 2 he pours two or three ounces of the alum solution; into No. 3 about the same quantity of the "fixing" or "hyposulphite"

solution. Now he takes the four-ounce measuring glass, and measures into it, using the small graduate, 40 to 50 minims of the ten per cent. solution of pyrogallic acid, and about 100 minims of ten per cent. solution of carbonate of potash. He then pours water into the measuring glass up to 2 ounces.* This is now the developer ready for use. Two ounces is perhaps a somewhat extravagant amount to use for a quarter-plate, and, after some practice has been gained, it may be somewhat reduced, but at first it is best to use a good dose. Everything is now ready. The white light must be entirely extinguished, and the red or yellow light lowered as much as possible, till there is just enough to see by. The plate which has been exposed must be carefully removed from the dark slide, and laid —film side upwards—in dish No. 1, which is still empty. Now the dish with the plate in it is taken in the left hand, and the measure with the developer in the right. The developer is poured rapidly, but gently, over the plate, the dish being waved or rocked to make the liquid cover any corner which it may incline to avoid, and the whole is placed again in front of the red light, where it is kept in constant gentle motion. And now (if everything has been rightly done) will begin one of the most wonderful of the phenomena of science or nature which man has been given the power to control—a phenomenon which is always new and always beautiful—the "development of the latent image." Let the beginner watch it closely. The plate has no indication of having been acted upon at all before the developer was poured over it. After, perhaps, twenty or thirty seconds there is a slight darkening of some part. When this becomes distinctly visible the light may be somewhat raised,

* Ten per cent. solution of pyrogallic acid ... ... 3 c.c.
Ten per cent. solution of carbonate of potash ... 7 c.c.
Water sufficient to make the whole quantity up to... 60 c.c.

for the plate has become less easily affected by it.* It will now probably be seen that the brighter parts of the landscape have become quite visible—in *negative,* be it remembered; the sky will be represented by blackness. Now is the time when we can tell whether or not the exposure has been correct. If it has been, the development will progress with beautiful regularity.

The bright parts (or high-lights) appear first; then slowly, but steadily, more and more of the half tones, or less brightly-lighted parts come out; and at last every object and shade except the deepest shadows have their counterpart in the negative. In other words, the plate should be darkened to a greater or less extent in all parts except those few which represent the part of the landscape which appears to the eye quite black; and this should come about within a few minutes. If the plate have been under-exposed, it will be longer before the high-lights appear, and soon after they do the action will stop, no more detail coming out, but large patches of the plate remaining white as before. If, on the other hand, it has been over-exposed, the high-lights will appear a little sooner, and almost immediately afterwards the whole of the plate will be covered with detail, no part remaining white.

The final result of incorrect exposure is, with under-exposure, a hard picture with contrasts over-marked, and with deep,

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* All this intense care about the light used is not absolutely necessary after a little experience has been gained. Most experienced photographers prefer to work with a light sufficiently bright to enable them to see quite easily after they have become accustomed to the dark-room, but keep the developing tray covered with a light wooden or cardboard cover, raising this for a second or two at a time only to observe the progress of development; but it is advisable that the beginner, to gain experience, watch the whole process of development, and if this is done, great care must be taken to keep the light as low as will still allow the plate to be distinctly seen.

heavy shadows, in which none of the detail which is visible to the eye is represented; with over-exposure, a flat, uninteresting looking production, showing all the detail which there is in the original, but lacking bold contrast of light and shade.

Let us suppose the happy medium to have been hit, if not at the first attempt, after a few plates have been exposed. The development is not of necessity finished when, looking on the surface of the plate, all action seems to have ceased. We have still, as a rule, to wait till the "density" is sufficient.

A little reflection on the principles involved in the process of printing, which was briefly described in a former chapter, will show that not only is it necessary for the production of a harmonious picture to have all the details which are in the original represented, but in the negatives these must be represented by a certain definite amount of opacity—or, as it is usually called, density. It must be understood, then, that as long as the plate lies in the developer, even after, when looking down upon it, all action seems to have stopped, the density continues to increase. We may say at once that the most difficult thing of all to judge of in gelatine dry plate work is when the required density is gained. So difficult is this, that even the most experienced photographer may occasionally fail. The reason of this is that the after processes very much modify the apparent density of the negative, and not only that, but in every different make of plate the apparent density is modified to a different degree. We must make it appear far denser than it is eventually to be. It is only by experience that knowledge approaching to exactness can be gained on this point. When I come to the chapters on printing, I shall explain more fully the characteristics of an over-dense, and a "thin" or under-dense negative. Just now I shall merely indicate the manner in which it is usual to judge of the density. The red or yellow light must be turned pretty high. The plate ust be lifted from the

developer, and held, with the film side towards the observer, for a second only, close to the light, and between the light and the photographer. He must rapidly judge whether or not the density is correct. It may be roughly said that, as a rule, the densest parts should appear almost, if not quite, opaque. If they do not, the plate must be returned to the developer.

I shall suppose the correct density to have been gained. The time taken with the developer I have given will probably be from three to six minutes. The developer is now poured back into the measure. If used within an hour or so, or any time before the colour has turned a dark brown, one or two more plates may be developed with it. The plate, after development, is rinsed under the tap, being either held in the hand, or left in the flat dish. After this, as much red light may be admitted as is desired. Then the plate is laid for five minutes in the alum solution, to harden the gelatine film. It is again thoroughly rinsed, and is placed in the fixing solution.

It will have been observed that up till this time the plate, looked at from the back, still appeared white. This is because the sensitive salt of silver which was not acted upon by light still remained in the film. On placing the plate in the hyposulphite, this whiteness will gradually vanish. When there is no further appearance of it from the back, white light may be freely admitted. The plate must still be left a few minutes in the fixing solution, however, after which it must be most thoroughly washed. It should remain at least half an hour either under running water, or in frequent changes of clean water. After that, it is reared upon edge to dry, when the negative is complete. Heat must on no account be used in drying.

CHAPTER VI.

LENSES.

Of all the apparatus which the photographer uses, there is none of so great importance as the lens. With a bad camera, shift can be made, and excellent work turned out, the only drawback being more labour and inconvenience for the operator; but with a bad or unsuitable lens, nothing good can be done. This being the case, it is desirable to give a short description of the various lenses in use, saying for what kind of work each is best suited. Before doing so, however, I will give a few general facts with regard to lenses, and especially I shall lay stress on the manner in which it is possible to compare the rapidity of different lenses. It will be necessary to define a few technical terms continually applied to lenses.

The *focus*—or, more correctly, *focal length**—is the distance between that point (generally in the lens) where lines joining points in a distant object and in the image cross each other, and that point on the axis of the lens where parallel rays of light are brought to converge to a point by the lens. It is commonly

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* When the focus or focal length is talked of, "equivalent focus" always is meant. The term "back focus," frequently used by opticians, means simply the distance between the back glass of a lens and the ground glass. This distance it is not important to know, except in connection with the adjustment of the lens or the camera.

spoken of as the "equivalent focus" in the case of compound lenses, the meaning being that these lenses give a size of image "equivalent" to that given by a small double convex lens of certain focal length.

This is possibly a meaningless definition to the beginner, in which case he need merely bear in mind that for the purpose of determining exposure, sufficient accuracy is gained in the case of a single landscape lens by taking the focus as the distance between the lens and the ground glass; and in the case of a double combination lens of modern construction, either view or portrait, by taking the distance between the diaphragm and the ground glass, a distant object in each being focussed.

In the case of the orthoscopic, and various other forms of lenses, this manner of determination is not sufficiently accurate even for the calculation of exposures; the following method of determination will, however, give results of sufficient accuracy. In front of the camera is placed a foot-rule, or other convenient object. The distance between the foot-rule and the lens, and that between the lens and the ground glass, are so adjusted that, when in sharp focus, the image on the ground glass is of the same size as the object. The distance from the foot-rule to the ground glass is now measured. This, divided by 4, is the equivalent focal length.

Example.—When we draw out a camera till the image on the ground glass is equal in size to the object, we find that the distance from the object to the ground glass is 32 inches. One-quarter of this, or 8 inches, is the equivalent focus.

The following method may be adopted when the camera will not rack out to twice the focal length of the lens. It is capable of giving very precise* results, but requires a slight knowledge of algebraical forms.

* Not mathematically accurate, but well within the limits required by the photographer.

d = distance from object to ground glass when a near object is focussed.

o = length of object focussed (preferably a measuring rod).

i = length of the image of this rod on the ground glass.

F = lesser conjugate focus—that is to say, the distance that may be between the optical centre of the lens and the ground glass when a near object is focussed.

f = equivalent focus.

$$F = \frac{i \times d}{o + i}$$

$$f = \frac{F(d - F)}{d}$$

Example.—A 5-foot rod is focussed. The length of the image on the ground glass is found to be 6 inches. The distance between the rod and the ground glass is found to be 10 feet 1 inch.

$$F = \frac{6 \text{ ins.} \times 10 \text{ ft. } 1 \text{ in.}}{5 \text{ ft. } 0 \text{ in.} + 6 \text{ ins.}} = \frac{6 \times 121}{60 + 6} = \frac{726}{66} = 11$$

$$f = \frac{11\,(121 - 11)}{121} = \frac{1210}{121} = 10$$

Equivalent focus, therefore, is 10 inches.

The aperture of a lens is the diameter of the smallest combination forming it, or of whatever stop smaller than this may be in the lens.

By *full aperture* of a lens is meant, in the case of a single achromatic lens, the diameter of the largest stop with which the lens will give good definition in one plane; that is to say, the diameter of the fixed stop with which the optician fits the lens. In the case of a double combination lens, it is the diameter of the front combination if the two be of equal diameter; of the smaller combination if the two be of unequal diameters; or of the fixed stop if such be smaller than either of the combinations. In the case of a triplet lens, the "full aperture" is

the diameter of the smallest combination, or of the fixed stop if this be smaller than any of the combinations.*

By *depth of focus* is meant the power in the lens to represent sharply objects both near and far from the lens. The larger the aperture or the longer the focus of the lens, the less the depth of focus. With every lens is supplied a set of stops or diaphragms. These are simply thin metal plates with holes of larger and smaller sizes in them, that are made to slip in front of or between the combination of a lens. The more depth of focus is needed, the smaller stop must be used, and consequently the slower the lens will be.

By *width of angle* is meant the amount of picture which can be included without complete falling off of definition, or of light, towards the edges of the plate. Let us suppose that a camera with a certain lens is placed opposite a row of houses. It is necessary, to illustrate this point, to suppose the camera to have a very large ground glass, larger than there is any chance that the lens will cover. It may be found that only the central part of the ground glass shows a sharp image, all beyond being "fuzzy," or even quite dark. Possibly two houses are represented correctly. Now let us suppose another lens of different make, but of the same focal length, to be substituted for the first. The two houses which gave a sharp image on the ground glass before, will give a precisely similar image now; but possibly a house on each side of these will also be defined sharply. In this case the latter lens is comparatively a wide-angle one. It must be understood that narrow and wide-angle lenses give images of the exact same scale if the focal lengths be the same; the latter form of lens takes in a wide-angle, only

* The definition of "full aperture" is not strictly correct as described for double and triple combination lenses, but it is accurate enough for all practical purposes.

on a larger plate, or on the same sized plate only, by using a lens of shorter focal length.

Distortion is a fault met with in some photographic lenses. It causes straight lines near the margin of the object to be represented by curved lines in the image.

Flatness of field is, roughly speaking, the quality in a lens of having the definition at the edge of the plate good as well as that at the centre.

The *rapidity* does not need to be defined, but I propose to explain the factors regulating it. Every lens is of different rapidity from others of another form, and each lens has a number of diaphragms varying its rapidity, so that at first sight it might appear a difficult task to put a value on the speed of a lens using any particular diaphragm. The law which governs the rapidity of lenses is, however, so very simple that its application is most easy, and I would try to impress upon the beginner that he should thoroughly master it at the beginning of his practice. If he do so he will find the estimation of the necessary exposure a comparatively simple matter. In changing one stop for another, or one lens for another, he will have nothing to guess except the intensity of the light. I give, further on, a set of tables which almost entirely do away with the necessity for even this small amount of calculation.

The method of comparing lenses—one which applies to all lenses—is as follows. State the ratios between the apertures of the lenses and the focal lengths of the lenses as fractions—the aperture as the numerator, the focal length as the denominator. Square the fractions thus obtained, and the resulting figures will give the ratios of the rapidity. It is usual to state the fractions thus: $f/4$, $f/12$, $f/40$. These fractions refer to lenses, the first of which has an aperture one-fourth of the focal length, the second one-twelfth, and the third one-fortieth. We

shall take a practical example. We are using a portrait lens 10 in. focus, and aperture $2\frac{1}{2}$ ins.; that is, the focal length is four times the aperture, or we may say the lens is working at $f/4$. The focal length, be it remembered, is taken at the distance between the diaphragm and the ground glass. We now substitute a single lens of 12-inch focus with a stop $\frac{3}{4}$-inch in diameter. The aperture is now $\frac{1}{16}$ of the focal length. The lens is working at $f/16$. Square these two fractions, thus:—

$$(\tfrac{1}{4})^2 = \tfrac{1}{16},\ (\tfrac{1}{16})^2 = \tfrac{1}{256}.$$

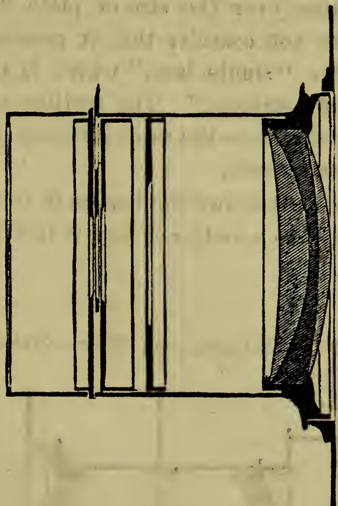
The rapidity of the lenses is as $\frac{1}{16}$ to $\frac{1}{256}$. The exposure needed will therefore be as 16 to 256, or as 1 to 16. Thus, if we had been giving two seconds with the portrait lens, we should have to give, on the same subject, thirty-two seconds with the single lens. If the beginner will exercise himself in this rule for a little time, he will find that he soon gains great facility in applying it, and that it gives him a ready power in estimating the necessary length of exposure. With the same lens and different stops, the rapidity varies as the square of the diameter of the stop, or as the area of the stop.

I shall now rapidly describe different kinds of lenses most in use, giving the purposes for which each particular form is best adapted. We have first

The Single Lens.

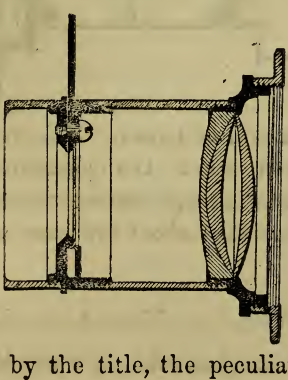
It is the simplest form of lens, and is in many respects excellent. It is fairly rapid, especially in some of the new "long focus" forms, includes all the angle that is desirable for general work, and gives wonderful definition, whilst it is the least expensive form of lens made. Its only drawback is that it gives slight distortion. If, for example, it is attempted to photograph a building with it, nearly the whole plate being covered, the boundary lines will appear slightly curved, and the building will seem somewhat barrel-shaped. This distortion

is, however, barely perceptible if the focal length of the lens be at least 1⅓ times the length of the plate, and, if the



beginner cannot well afford to buy the "rapid rectilinear," he will find that he can do excellent work with the "single achromatic."

The next cut shows Dallmeyer's new rectilinear landscape

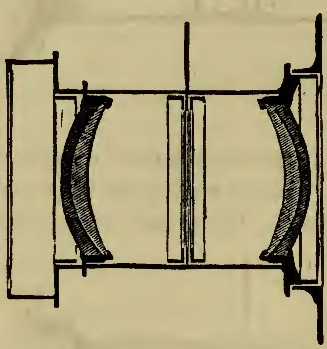


lens. As indicated by the title, the peculiarity of this lens is

that it does not give the distortion mentioned above. The writer has found it an excellent lens in practice, giving great evenness of definition over the size of plate it is intended to cover, but he does not consider that it possesses the peculiar characteristic of the "single lens," which is the existence of only two "reflecting surfaces." The rectilinear landscape lens has four reflecting surfaces—the same number, that is to say, as most other rectilinear lenses.

By a mistake this cut shows the lens as if it were fitted with rotary diaphragms. As a matter of fact, it is fitted with Waterhouse diaphragms.

THE RAPID RECTILINEAR OR RAPID SYMMETRICAL

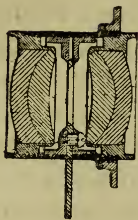


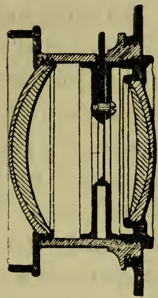
is one of the most useful of lenses. It is very rapid, and one should be purchased when the photographer has so far advanced as to wish to attempt instantaneous effects. It gives no distortions, and includes about the same angle as the single lens.

THE SYMMETRICAL OR WIDE-ANGLE RECTILINEAR

is a somewhat slow lens, but takes in a wonderfully wide angle,

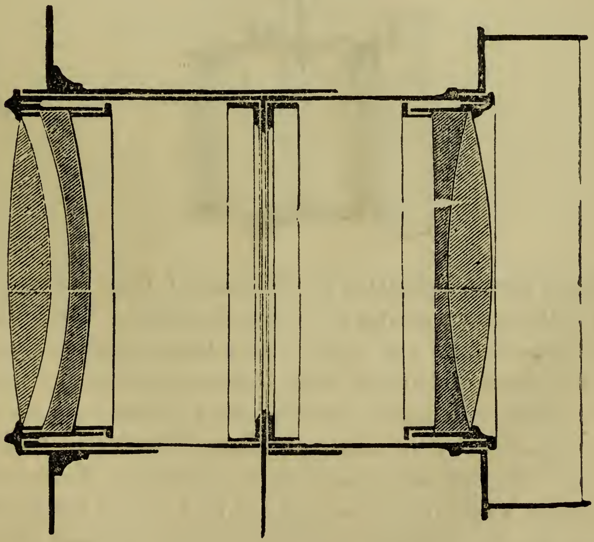
so that it is useful for photographing objects when it is im-





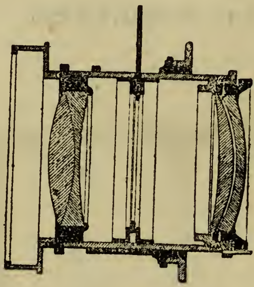
possible to get the camera far enough away from them to use the rapid rectilinear. It is quite free from distortion.

THE PORTRAIT LENS



is intended for portraiture pure and simple. The utmost ingenuity has been spent in the case of this lens to get the

greatest possible rapidity, but many other good qualities have been sacrificed. Thus the field is round, the marginal definition bad, and there is very little depth of focus. For its own particular purpose it was, however, in the days of wet plates, admirably adapted. With the very rapid plates that can now be had, it is quite possible to take portraits even indoors with the rapid rectilinear or the single lens, and we do not advise the beginner to purchase a portrait lens. This is particularly true since the introduction of several forms of lens of the rapid rectilinear type, working at twice the aperture of *f*/8, which used to be the standard aperture for such lenses. The newer forms of rapid rectilinear need only about twice the exposure needed with the portrait lens.



This cut shows Dallmeyer's "diffusion of focus" lens. The object of the arrangement may be thus described. The ordinary portrait lens defines one plane with intense sharpness, but, on account of want of depth of focus, defines all others but poorly, and the want of definition in these other planes is made painfully conspicuous by the extremely sharp definition in one. To overcome this difficulty, the lens we illustrate above has an arrangement whereby, unscrewing the back cell of the posterior combination, the definition even in the best defined plane is somewhat softened, whereby the painful contrast of very sharp definition and want of definition mentioned above is avoided.

The amount of "diffusion" can be varied at the will of the operator. For a single standing figure it may not be wanted at all. The greatest quantity of it is wanted for large heads.

There are numerous photographic lenses sold under names different from any of the above, but all of them will be found to be very similar in action, if not in construction, to one or other of the kinds illustrated. As I am entirely avoiding in these pages all historical reference, I do not describe these lenses, which have now almost gone out of use, and are not manufactured; but I may mention the "orthoscopic," "orthographic," "wide-angle doublet," "instantaneous doublet," and "triplet" lenses as instruments to be occasionally met with, and which, if not quite so good as our more modern instruments, nevertheless possess excellent qualities.

Different Forms of Diaphragms.

The older form of the diaphragm consisted in a circular metal plate with a hole in the middle of it. At the present time there are used three different kinds of diaphragm described below. The object of the diaphragm is the same in every case, but one form is found more convenient with one form of lens, another with another.

The Waterhouse Diaphragm.—Each such diaphragm consists of a plate of metal that can slide into a slit in the mount of the lens. There must be a set of several such diaphragms, and they are generally fitted in a small leather case. These diaphragms being separate, pieces are liable to get lost, or mislaid. They are now commonly used only for lenses of large diameter.

The Rotary Diaphragm.—This diaphragm consists in a circular metal plate with a number of circular holes or "apertures" in it, so arranged that, by turning the plate on its centre, any one of these apertures may be brought into position. The rotary diaphragm, forming part of the lens, is not liable to

be misplaced. It is, however, adaptable only to lenses of the slower kinds, whose maximum apertures are small. Indeed, it is commonly fitted only to wide-angle lenses.

The Iris Diaphragm has gained much popularity of late, and deservedly. It consists of a series of thin metal sheaths, each centring on a pin, and so arranged that, by either moving a small peg that projects from the lens mount, or rotating a ring that surrounds it, the aperture remaining almost perfectly circular, alters in size as the iris of the eye does on change in the intensity of light. The iris is far the most convenient of all diaphragms. It can be fitted to any, or nearly any, kind of lens. The only objection to it is that it is comparatively expensive.*

Since this chapter was written, two great improvements have been made in photographic optics. One consists in the introduction of what are known as "Anastigmatic" lenses, the other in the invention of the tele-photographic lens. The necessary limits of a shilling hand-book forbid the writer from illustrating these lenses, or describing them at any great length; but the following brief description may be of use to readers.

Anastigmatic Lenses take the place, according to their construction, of wide-angle rectilinear lenses, rapid rectilinear lenses, or even portrait lenses. Their chief advantage is that they show markedly better marginal definition than any of the older forms of lens. The price is, however, much greater. It is quite a matter of opinion whether, for the work of the amateur, it is worth paying this extra price, as many hold that the older forms of lenses give all the definition, both marginal and otherwise, that is wanted for pictorial work, some even going the length of saying that the slight falling-off of marginal

* The whole of the subject treated of in this chapter is much more fully dealt with by the writer in "OPTICS FOR PHOTOGRAPHERS," published by Messrs. Piper & Carter

definition given by these older forms actually adds to the pictorial effect. For a great many kinds of special work, such as line work and photographic surveying, there can be no doubt of the vast superiority of the new lenses.

Tele-photographic Lenses.—A tele-photographic lens consists of a portrait lens, or a rapid rectilinear, with an attachment that extends into the camera. This attachment holds a "negative element" (or, in popular language, a diminishing lens), which has the effect of giving a much larger image than could otherwise be got with the same extension of the camera, and, moreover, enables the photographer, by adjusting the extension of the camera and the distance between this negative element and the other lens, to get, within wide limits, any size of image that he wants.

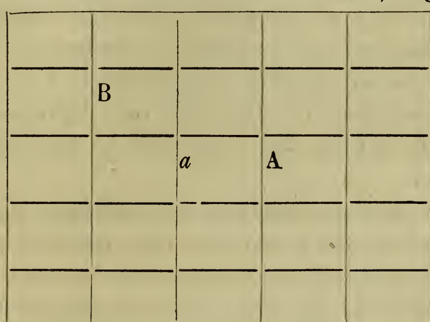
CHAPTER VII.

THE MANAGEMENT OF THE CAMERA IN THE FIELD—THE SWING-BACK, RISING FRONT, ETC.

If the photographer has diligently perused the preceding chapters, and has gone through the various manipulations described in them, he will now be ready to sally forth into the field, and, selecting the beauty spots of nature, to transcribe them by the aid of his camera and lens. He may, in fact, make pictures.

I have declared my intention of not entering into the question of art in connection with photography, but have referred the reader to more advanced works for guidance in this direction. Yet a few general remarks on the subject, made with much diffidence, may not be out of place, especially in indicating those points wherein the requirements for a photographic picture differ from those for a painting. The chief of these arises, of course, from the absence of colour in the former. We cannot have transcribed by the camera the broad contrasts which are frequently brought out by colour alone. We must trust entirely to form and to light and shade. Very frequently a scene will make a most perfect picture on the camera ground glass, when the experienced photographer knows it will make nothing in the print. Alas! the colour which makes the picture cannot be reproduced.

This makes it all the more necessary in the case of the camera to have the outline and the shades of light harmonious and well balanced, for on them alone must the picture depend. The picture must not be all on one side, nor yet should it be in each half similar. The most striking object should not, as a rule, be in the centre of the picture, but somewhat to one side or the other, there being an object of secondary interest on the opposite side of the picture—but not symmetrically opposite—to balance it. Mr. Norman Macbeth, a painter of much talent, has read various papers before photographic societies, propounding the view, that if the space occupied by the landscape be divided horizontally and vertically into five or seven equal portions, the primary and secondary points of interest should fall on the intersections of these lines, but not on bi-laterally symmetrical intersections. To illustrate this, I give a set of



intersecting lines as described. If, now, the primary point of interest be at A, the secondary point of interest must not be at *a*, but at B.

The horizon line should, as a rule, be about one-third or two-fifths of the height of the picture, either from the top or the bottom. There must not be too large patches of either very dark shade or of light without some small portions of the contrary shade to relieve them.

For the rest, there is generally wanting to a perfect landscape picture—be it painting, drawing, or photograph—a foreground, a middle distance, a distance, and a *principal object.* This latter is generally situated in the foreground or in the middle distance. It is in the distance that photography oftenest fails. What to the eye appears a definite distant landscape—the distance but lending enchantment and softness—comes out in a photograph so dim and faint that it would seem to be almost hidden by a thick mist. The slight haze which, in England at least, generally appears between us and the distance, is exaggerated so as almost to obscure those things which are quite clear to the eye. A certain amount of haze covering the most distant objects in a photographic landscape is, indeed, necessary to give the idea of distance at all, and on the way in which this is managed will depend, more than on anything else, the success or failure of the picture from an artistic point of view. The difficulty is to be found in the fact that the haze actually seen is always greatly exaggerated in the camera. It is, therefore, necessary to allow for the difference between what is seen in nature, and what will be the result in the finished picture.

Perhaps the greatest difficulty in landscape photography, however, is that the sky is not, as a rule, rendered at all. An exposure which will suffice to bring out all the detail in a landscape, is such that the sky will be so over-exposed as to show no trace of cloud, but only an even expanse of white. It is necessary, to get the sky, to make a special exposure, perhaps about one-tenth of that needed for the landscape, and to resort to a "double-printing" process, to be described hereafter.*

I shall briefly describe the subjects best suited for the camera. Landscapes having, apart from colour, broad and well-marked

* See a description farther on of orthochromatic or isochromatic plates.

contrasts of light and shade, and decided outline of form, are specially suitable. Trees of all kinds are well rendered, both with and without their leaves; in the former case the difficulty is to get them motionless. A quite windless day is necessary, unless the light be so good that the exposure need be only a fraction of a second. Architectural subjects of all kinds are most perfectly reproduced by the camera.

The most charming effects of any are, perhaps, produced in a scene in which there is water—a quiet pool with reflections of trees, for instance ; shipping in motion, &c., will be treated of in the chapter on instantaneous work.*

Let us suppose some locality has been determined on where the photographer is sure to find subjects such as those which have just been mentioned. I shall describe, as accurately as I can, how he should proceed. Before he leaves home he has to fill his slides. After he has done so, he should draw out each shutter of each slide, and gently dust the surface of the plate

* The above is a brief epitome of a set of general principles that have never been taken as absolute rules, but that have been believed to give useful assistance to many photographers who have tried to produce really artistic pictures. Since it was written, there has arisen a school of photographers calling themselves "naturalists," who discard all such rules even as suggestions. Their views are represented—or rather, perhaps, it would be more correct to say they arose from—a book entitled "Naturalistic Photography," written by Dr. P. H. Emerson. [Dr. Emerson having recanted all that he taught in this book, it is difficult to know what to say, but that the discussion that arose from it, and the attention that it drew to the artistic side of photography, has done much good.] This book should certainly be read by all photographers. It displays much originality, and, in spite of what are considered by many to be grave errors, the student cannot but learn much from it—at least, from those parts that treat solely on the art part of the question—and they would certainly learn more if the author had been more tolerant and less dogmatic. Those who wish to gather the views of the older school, which Emerson strongly opposed, should read the works of H. P. Robinson.

with a piece of soft cotton-wool, or a camel's hair brush. Let us suppose he has three double slides, they must be packed into a case which should be made to hold them and the camera. Besides these, he must take his lens, his tripod—and let him be most careful not to leave the screw behind him—his focussing cloth, and possibly a "focussing magnifier." This is a small eye-piece to magnify the ground-glass image, and assist him in focussing with precision. It is useful greatly because it increases the light. When a small stop is used, the ground-glass image is often so dull that it can barely be seen.

Arrived at the scene of action, the photographer must select his point of view most carefully. Let him be in no hurry; often a picture will be made or spoiled by changing by a few yards the position of the camera. When he has quite made up his mind, let him unfold his camera, erect it, and place it before the scene to be depicted.

A few words on the management of the tripod stand. With the beginner this is apt to prove most wonderful and fearful in its movements. The effect of moving any one leg appears to be the exact opposite of what might have been reasonably expected. After long struggles the whole apparatus assumes an appearance of hopeless intoxication, and finally collapses, very possibly pinching severely the tyro's fingers between the tail-board and one leg; after which frequently follows language not to be repeated by this writer. Let the stand be, however, once for all placed on the ground with its three legs about equally far, and a good distance, apart, and with one of them pointing in the direction of the scene to be photographed, and all trouble will cease. There will be room for the photographer to focus comfortably standing between the two back legs. To tip the camera up, all that is necessary is to draw the forward leg towards him; to tip it down, he need only push it from him. He may still further tip the camera up by spreading the back

legs apart; and down by bringing them together. He may turn it slightly to one side or the other by swivelling it on the screw, without moving the stand.

When the camera is fixed, and the view is focussed, it will probably be found that there is too much foreground and too little sky. Now, one of two things may be done. The camera may be "tipped" up. In this case, if there be any parallel vertical lines in the picture, they will be made to converge towards the top, and it will be necessary to bring the swing-back into play, as will be shortly described. If there be no vertical parallel lines, the camera may be tipped a little without appreciably modifying the result, or the camera front and lens may be raised in the manner to be described hereafter. Most cameras are made so that either a vertical or horizontal picture can be taken, and judgment must be used to determine in which position it shall be. All the points above indicated having been considered, and the picture being all on the ground glass—proceedings so far having been conducted with open aperture or a large stop—the final focussing must be done, and of this final focussing it may be said that it depends on it, next to the selection of the view itself, whether a picture will result or not. Indeed, a quite indefinite amount of skill may be shown in deciding two things, namely, what plane shall be focussed for, and what stop shall be used.

It is a question of dispute whether any part of a photograph should be as sharp as a good lens can make it, or not. It is the writer's opinion that, at least, some one part of most photographs should be as well defined as possible, but this is a thing to be decided by each photographer for himself. If it is decided that no part of the photograph is to be quite sharp, either a lens with some spherical aberration—that is to say, a lens that will give nothing quite sharp—must be used, or, after the nearest object in the view has been focussed for, the camera

must be racked out a little bit, so that even this will be slightly out of focus.

The following hints may be of use. The object in sharpest focus should generally be the nearest object to the camera that is of any interest. Often this will be the object of principal interest. This having been focussed for, it must be decided to what extent other planes are to be made sharp, or left with only partial definition, an affair determined entirely by the diameter of the stop used. If the object of greatest interest be in the middle distance, it may be left a *very little* out of focus. The distance may generally be left quite perceptibly out of focus, although whether this is advisable or not will depend entirely on the nature of the subject. A very small part of the foreground distinctly out of focus will generally spoil a picture altogether.

Focussing is commonly done with the full aperture of the lens, but some lenses have a little residual spherical left to give a soft effect in using the full aperture. With these the focussing should not be done with full aperture, unless such is actually to be used. It is a good thing to make it a rule with all lenses but those of the wide-angle type to focus with the stop to be used if it be one of the two or three largest, with a stop about half the diameter of full aperture if a small stop is finally to be inserted.

Whatever effect has been decided on, it is got by inserting smaller and smaller stops, examining the image on the ground glass after the insertion of each.

Now all is ready for exposure. Let plate No. 1 be exposed first, and on no account let any plate be exposed other than in its order, else the photographer will be likely to expose two views on the same plate. A much more irritating thing he cannot do. In exposing, procedure is exactly as described in a former chapter. There is given further on a set of Tables, from

which may be learned, as accurately as it is possible to learn from anything but judgment gained from experience, the exposure which it is necessary to give for different subjects.

It may be said that, for a landscape, the most pleasing lighting is usually a side lighting. The lighting looking towards the sun is sometimes very pleasing, but care must be taken not to include the sun itself. This must be either to one side of or above the picture, or may be kept out of it by the camera being placed in the shadow of a tree or some such object.

In the older days of photography it was not considered possible to get good landscape effects but in bright sunshine. There has been a great reaction against this idea lately. Like most reactions, it has gone too far, some seeming to think that artistic landscape effects are to be got *only* when the weather is dull, nay, gloomy. This is absurd, but it should always be borne in mind that delightful effects are often to be got when the sun is quite hid by clouds, and even at times when it is raining.

The Use of the Rising Front and the Swing-Back.

In the case of most cameras, the board in front of the camera which carries the lens is so constructed that it can be raised to a certain extent, the object in raising it being to get in high objects, and to reduce the amount of foreground seen, which is usually too great when the camera is placed horizontally and the lens is not raised. Many cameras are, as has already been mentioned, fitted with a swing-back, as well as a rising front. The use of this adjustment needs some consideration, as it is often a stumbling-block to beginners, or even sometimes to experienced photographers.

When the subject includes no parallel vertical lines, and when it is seen that it is desirable to take in more of the upper part of it, it is best to tip the camera to a moderate extent. It is not desirable, however, to tip it very much; so if six or eight degrees

off the horizontal do not yet let enough of the top of the subject be taken in, the front carrying the lens should be raised till it include all that is wanted. So much for the case of a pure landscape subject, in which there are naturally no quite parallel vertical lines.

In the case, on the other hand, of architectural subjects, it must be taken as an absolute law, that if it is wished to have the vertical lines of the subject rendered as parallel lines in the photograph, the ground-glass of the camera must be kept vertical, whether this object be attained by keeping the camera horizontal and raising the front, or by tipping the camera up and swinging the back, so that the latter returns to the vertical.

It may be said that, so far as it is possible to do so, the desired result should be brought about by raising the lens, as the latter is thereby less "strained," so to speak, than when the camera is tipped and the back is swung. What is meant by saying that it is less strained, is that its powers are less taxed, so that it is possible to get equally good definition with a larger stop.

There are two limits to the amount to which the camera front may be raised: the first is a purely mechanical one, and depends on the fact that in all cameras there is only a certain range of rise given; the second depends on the lens. It is evident that, if a lens will just only cover a plate when it is opposite the centre thereof, and if the lens be then raised, the lower part of the plate, representing the upper part of the subject, must simply remain blank. The lens will not cover it at all.

It may be said then that the lens should, for high architectural subjects, be raised till one of the two limits mentioned is reached, after which the camera should be tipped, if it is still necessary.

It is held by most that vertical lines in architectural subjects should be rendered as absolutely parallel lines on the photo-

graph. The writer is of the opinion that a very slight convergence towards the top is not only allowable, but desirable, especially when a very high and narrow building is to be photographed. The amount should be very slight, however.

It should be borne in mind that to tip the camera does not strain the lens at all, if the back be allowed to remain perpendicular to the axis of the lens; that to raise the lens strains it a little; that to tip the camera, and then swing the back, strains it very much indeed, necessitating the use of an exceedingly small stop.

The use that has just been described of the swing-back is very simple; but there is another use to which it is frequently put, and this fact, that the swing-back may be used for two totally different, and as may almost appear, opposite purposes, is the reason why it is often such an incomprehensible arrangement to the beginner.

I shall give a typical case, in which the swing-back is used for the second purpose, when I hope the matter will be quite clear.

We have a pure landscape to photograph, in which we wish to take in, to form the bottom of the picture, a piece of foreground which is not many feet from the camera. The middle of the picture will be filled with a portion of ruined wall at some little distance, whilst behind that is to be seen, at a much greater distance, a rugged crag rising nearly to fill the whole picture. Now we know already, that to have a near object in focus involves racking the camera further out than when we focus for a distant object. To have all the three objects mentioned in focus at the same time would necessitate having the ground-glass at different distances from the lens, the bottom nearer than the centre, and the centre nearer than the top. Now it will be evident, after a moment's consideration, that this condition is fulfilled by swinging the back of the camera *away*

from the lens. The only difficulty is to know to what extent we must swing. This is discovered in the following manner by trial and error :—We swing the back to a certain extent, then focus for the centre of the ground-glass. We now notice whether the top part—representing the foreground—can be made sharper by racking the lens either a little farther from or a little nearer to the ground-glass. If we have to rack it a little faither away, the back has not been swung enough; if we have to rack it nearer, it has been swung too much.

Some cameras are fitted with a "side swing" as well as a "vertical swing." This is be used precisely as just described, but when one *side* of the subject is nearer the operator than the other.

CHAPTER VIII.

INSTANTANEOUS PHOTOGRAPHY AND HAND-CAMERA WORK.

Although "instantaneous" photography was practised to a certain extent before the advent of gelatine dry plates, the difficulties in the way of success were so great, that only a few of the most skilled ventured to attempt it. Now all is changed. So easy is it to take what are called instantaneous views, that there is no reason why such should not be included among the work even of the beginner.

The term instantaneous is a most indefinite one, and one that might with advantage be disused, could a better be found. It means, of course, a very short space of time, and, with regard to photography is, we may state, commonly used to designate an exposure varying from about half a second to a very much briefer period of time—for the subjects which the landscape photographer is likely to attempt, say to the hundredth of a second. Much shorter exposures than these have been used for special purposes, but the results, however curious or scientifically useful they may be, can scarcely be called artistic.

For most subjects that are capable of forming a picture, exposures from a tenth or a twenty-fifth of a second are sufficiently short. Many instruments have been invented, and are sold with the object of making it possible to vary the exposure, and to adjust it to any desired fraction of a second.

It would be too much, probably, to say that any shutter completely fulfils these conditions. The writer has tested the speed of many shutters, and, in the case of those pretending to give definite small fractions, has seldom found that the claim was much more than a fashion of speaking. Farther than this, he has seldom found that shutters claiming to give minute fractions of a second gave exposures as short as they were supposed to. He has found only one shutter—and this for a lens of but small size—that gave an exposure of less than $\frac{1}{100}$th of a second. By far the greater number gave a minimum exposure of from $\frac{1}{25}$th to $\frac{1}{50}$th of a second, although many of these were catalogued as giving "exposures or less than a hundredth of a second."

Spite of all this, it must be admitted that there are now many shutters in the market of great ingenuity, exceedingly convenient to handle, and of the highest practical use, the more particularly if the user discount a little from the wonderful things that the makers profess their shutters will do.

It would not be fair, where there are so many excellent instruments, to recommend any particular one. I shall merely say that a shutter giving a variable exposure is to be preferred; that, in the case of compound lenses, there are several advantages in a shutter working between the combinations, and opening and closing at the axis, but that many shutters working in other positions work excellently in practice. Whatever form of shutter is chosen, it should be observed that it allow the lens to be fully open during the greater part of the exposure. This is, as a rule, accomplishable only by having the opening, or openings, that admit light long in the direction in which they move. Shutters with a pneumatic release, in which the exposure is given by pressing a small rubber ball at the end of a flexible rubber tube, are particularly convenient, and nearly all shutters are now made with such an arrangement.

As regards the subjects most suitable for instantaneous work,

a few words may be said. Of all such, sea scenes come first. Effects of sea and cloud alone often make charming pictures, with the addition of ships in motion even more so; river scenes are also well rendered. Much more difficult, and usually much less successful as pictures, are subjects including crowds of people. For such, the exposures must be longer, the lens must be used with larger aperture, or the plates must be more sensitive than for subjects of the nature of those first mentioned. Nevertheless, many wonderful representations of crowds on the sands of the sea-shore, in the streets, and so forth, and even representations of horse races, with their thousands of eager spectators, have been produced, and, indeed, as the last few years have seen a great increase in the sensitiveness of plates, and, as has already been stated, what practically amounts to a doubling of the rapidity of the lenses available, at least, for small work, the difficulties may have said to have disappeared, unless large work be attempted. It is for this kind of work that the hand-camera is particularly suited.

For the shorter exposures mentioned, it is evident that a mechanical instrument is needed. There are many such, but all are classed under the title "instantaneous shutters."

For the first object mentioned, however—namely, sea and sky, without moving shipping, or with only such as is in the distance, or is moving but slowly—an instantaneous shutter is by no means necessary, as a comparatively prolonged exposure may be given.

It is quite possible to give by hand, with a little practice, using the common cap, an exposure as short as a fourth or a fifth of a second. This is quite short enough for the effects which we are just now considering. The cap is rapidly lifted upwards to an inch or two above the lens, then quickly re-adjusted. It is evident that in this manner a somewhat longer exposure will be given to the sea than to the sky, but this is

an advantage rather than otherwise. It is advisable to use a very loose cap, or even one a size larger than that actually intended for the lens.

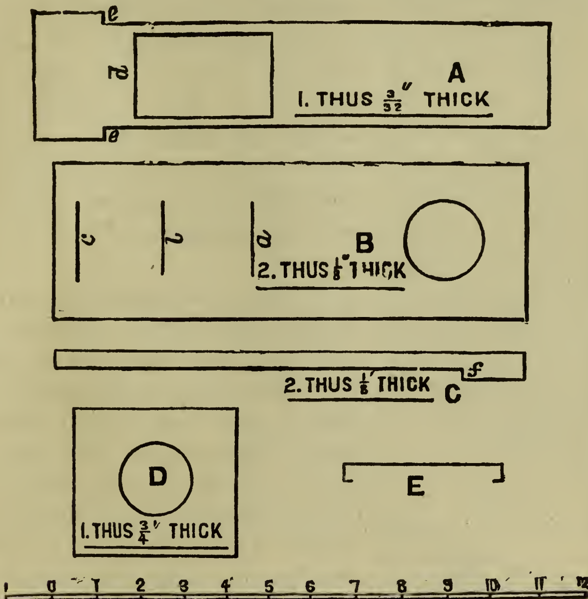
If ships or boats in rapid motion are to be included in the picture, or if men or animals in motion are to be attempted, an instantaneous shutter giving a short exposure is necessary, the aperture of the lens being increased to a corresponding degree.

When the first edition of this book was written there were but few mechanical shutters, and those were far inferior to the best of the present day. The writer, therefore, recommended a simple drop shutter. There are probably few now who will be satisfied with so primitive an instrument, but, as there may be some who, being mechanically inclined, would like to make a shutter with which excellent work may undoubtedly be done, whose only objection, indeed, for any but very rapid work, is its comparative cumbrousness, the description and cuts from the original edition is retained. The sketches given scarcely need explanation as far as construction is concerned (see next page).

A is the dropping piece; B, of which there are two, is one of the sides forming a frame through which A drops; C is a distance piece, of which, again, there are two, to keep the two B's apart; D is a thick piece of wood, in which there is a hole accurately cut to the size of the hood of the lens, so that it may support the shutter. The arrangement is here shown complete. Any hard wood forms a suitable material out of which to construct the instrument. The B pieces may, with advantage, be of vulcanite; A is better of wood. If it is made of vulcanite, considerably greater width than is shown must be allowed at each side of the aperture, or the drop is likely to snap the moving piece in two. The frame should be put together with glue and screws.

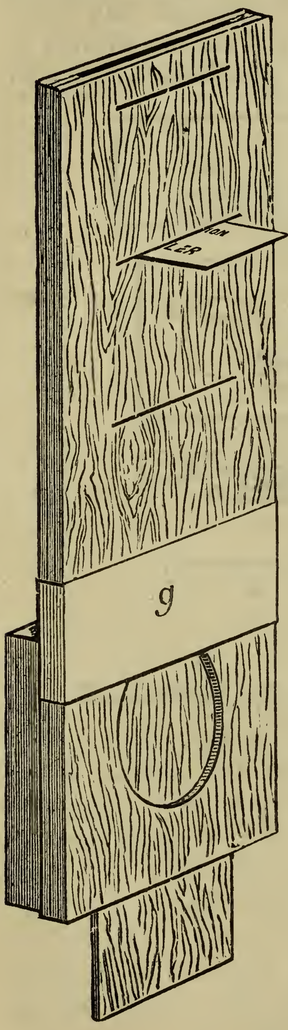
And now for the action of the arrangement. Of course it is understood that A slides easily, and without friction, between

the two pieces B. Indeed, it should drop almost without touching them; *a*, *b*, and *c*, are saw slits through both pieces B. They form a trigger arrangement, and also one whereby it is possible to give a variable exposure. Focussing is done with



the piece A entirely removed from the shutter. This is then inserted, a small piece of cardboard, such as a common calling card, being placed in one of the slits, *a*, *b*, or *c*, so that the dropping piece supports itself on *d*. If a comparatively long exposure be needed, the card is put into the slit *a*; if a short one, in the slit *c*; whilst for a medium exposure, *b* is used. The reason of the variation is not far to seek. The velocity of a falling body is, as we all know, uniformly accelerating. It is evident, then, that if the moving part has been allowed to fall for a certain distance, it will fall more rapidly across

the aperture than if the exposure began with the falling.



The fall is arrested by the projections *e e*, coming into contact with those at *f*. A shutter made to the size given is suitable for a hood $1\frac{1}{4}$ to $1\frac{1}{2}$ inches diameter. It will do well for a lens of the rapid symmetrical or rapid rectilinear type, suitable for plates $6\frac{1}{2}$ by $4\frac{3}{4}$, or a little larger. The lengths of the three different exposures given by it are approximately $\frac{1}{8}$, $\frac{1}{16}$, and $\frac{1}{20}$ of second.

In the accompanying sketch, showing the shutter complete, *g* is a piece of blackened tin or ferrotype plate, bent as shown at E, so that it may slide up and down in front of the aperture. By adjusting it, so as to cover a part—say a third—of the upper part of the aperture, the sky is somewhat shaded, without affecting the light the foreground receives, and thus a better result is obtained in certain cases. The lower edge of this shade may, with advantage, be cut into serrations like the teeth of a saw.

The feature most worthy of notice in the shutter described is the great length of the aperture of the dropping piece in the direction of its motion. This I consider a most necessary thing. It is impossible here to enter in detail into the reasons for so thinking. I will merely point

out that if the moving aperture be only the same length as the diameter of the aperture of the lens, the instrument is, during the whole time of exposure, either opening or closing, and the full force of the light only acts for an infinitely short period. The disadvantage of this does not need to be explained. In the shutter with a long moving aperture, it will be seen that there is the clear aperture of the lens during the greater part of the exposure.

The long aperture, and the arrangement for varying the exposure, involve a larger instrument than would otherwise be necessary, but I consider this disadvantage more than compensated for in the additional amount of light got.

In instantaneous photography the camera is manipulated as for ordinary landscape work up to the time when the exposure is to be made. The instantaneous shutter is then adjusted. The shutters of the dark slide must not be withdrawn till as nearly as possible before the exposure is made. The effect desired is watched for. Nervousness and hurry must be avoided, though it is difficult. It is much more common to expose just too soon, than just too late. When the exact moment has arrived, the shutter is put in motion, and the plate receives the actinic impression.

Hand-Camera Work.

The hand-camera has already been mentioned. The writer has expressed his opinion that it is not an instrument to put into the hands of a beginner; but any book of the present day, professing to treat of even elementary photography, would be incomplete without some mention of hand-cameras.

The advantage of the hand-camera is that groups are taken without their attention being attracted, and that thus a natural effect is got no to be had in any other way.

It would be out of place to recommend any particular kind of

camera here, and, indeed, I do not intend even to decide for the reader whether he should use films or plates; if the latter, whether he should use a magazine camera, a camera with a changing box, or with a set of dark slides. He should consult a general dealer in photographic apparatus on these matters, or should see what kind of work his friends are doing with hand-cameras, and choose accordingly. A few general hints only can be given here.

First, as to the external form of the camera. There is no need to go in for elaborate concealment of the fact that the apparatus is a camera. The attention of people is not so easily attracted as might be supposed. The writer has done nearly all his hand-camera work with an ordinary quarter-plate camera, not concealed in any way, and can remember of only two cases in which his pictures were spoiled by the fact that the attention of the subjects had been attracted.

As to size next. This must, of course, be a matter of opinion. The writer considers quarter-plate ($4\frac{1}{4}$ by $3\frac{1}{4}$) to be far the best size. Anything under that size he considers not worth producing, whilst if the size of the camera be greater, the difficulties in the way of lack of depth of focus, and so on, increase greatly. A 5 by 4 may, however, be worked with success.

The most important item of the outfit is, it need scarcely be said, the lens. There can be very little doubt as to the best form. It is a lens of the extra rapid rectilinear kind already mentioned, working at between *f*/5 and *f*/6. The focal length is a matter of great importance, nearly all hand-cameras being fitted with lenses of too short focus. The focus of the lens should be from $1\frac{1}{3}$ to $1\frac{1}{2}$ times the length of the plate. Thus, for a quarter-plate, a lens of about six inches focus should be used. The lens should be fitted with either a rotary or an iris diaphragm. One thing should be borne in mind in connection with the lens, and that is, that the depth of focus *is absolutely*

fixed by the focal length and aperture, so that, if we hear anyone talking of a certain lens as having greater depth of focus than another of the same aperture and focal length, we may be sure he is speaking in ignorance. In the case, however, of lenses of what are called "fixed focus"—that is to say, where there is no adjustment for focussing—the apparent depth of focus may vary greatly according to the way in which the lens is adjusted. The proper way in which to adjust such a lens is as follows:— A distant object is sharply focussed for, and then the lens is moved outwards till this distant object is just perceptibly out of focus. The lens is then fixed in its position. If the adjustment be made in this way, an object in the foreground will be sharp at just half the distance it will if the lens be absolutely adjusted for a distant object.

Lenses of fixed focus are, however, applicable only to very small sizes—much smaller than quarter-plate—so that, if the latter size be adopted, a focussing arrangement is essential.

The shutter of the lens must be rapider than is generally needed for a camera to be used on a tripod. The reason is that a very slight motion of the hand holding the camera makes as much blurring of the image as a very large motion of any of the subjects. It is difficult to do good hand-camera work with an exposure of more than about $\frac{1}{50}$th of a second.

A finder is almost essential for a hand-camera. Most have two, one for horizontal pictures, the other for vertical. The objection to most finders—indeed, to all the writer knows of—is that they necessitate the holding of the camera too low. For by far the greater part of hand-camera work, the level of the eye is the proper one from which to expose. If a hand-camera be held under the arm or against the breast, the picture got is not that seen in looking at the objects, but is a different one. It may be said that the picture, as it will be photographed, is seen in the finder. This is true, but the scale is generally too small

to enable the composition to be judged of. If pictures are to be taken by the hand-camera from a low point of view, the photographer should stoop down and still expose from the level of the eye. I hope some day to see a hand-camera so constructed that the image on the finder is visible whilst the camera is held on a level with the eye.

The mere operation of exposing by the hand-camera, apart from anything else, is one that needs much practice. The commonest subjects are street scenes, including, of course, houses. The fact that the camera must be held horizontally, otherwise the vertical lines will not be parallel, itself introduces a difficulty when the exposure must often be made on the spur of the moment so as to catch a certain effect.

CHAPTER IX.

PORTRAITURE.

To make portraits—to secure likenesses of his friends—is sure to be an early ambition of the photographer. In fact, he will show self-denial above the average in foregoing his natural desire if his first attempt be not to "perpetrate a portrait." Nor is this to be wondered at, for, indeed, there is a charm in portraying the human face and form, quite other and much greater than there is in making pictures, ever so truthful and beautiful, of stones, and trees, and things without life. Nor need the amateur despair, now that he has at his command the wonderful powers of the dry plate, of reaching a certain proficiency. True, in this department of photography he need not, unless he have very exceptional ability and much perseverance, as in landscape work, aspire to compete with the professional, other than the third or fourth-rate one; still a portrait done by a friend is sometimes looked upon in a kindly spirit by the original, and valued for the sake of the portrayer. In one point the amateur has an advantage: the surroundings and operations are not likely to create the awe and nervousness that appear to overcome some sitters whenever they enter the formidable studio of the professional.

Portraits may be done either out-of-doors or in an ordinary room. I put on one side the possibility of the amateur having command of a studio.

Out-of-door portraiture calls for little remark. It is comparatively easy ; but the results gained are not usually so pleasing as those of successful in-door work.

All that is necessary is to get a suitable place in which to operate. There must be some means of shutting off a portion of the top light. This may often be secured by taking advantage of the outspreading branches of a tree. The position chosen must be such that there will be a somewhat stronger light on one side of the sitter than on the other ; by this means there are secured relief and roundness. If a full-length sitting or standing figure be attempted, a natural background, such as an ivy-covered wall, the stem of a large tree, or such like, is the best. If heads be done, an artificial background, such as will be described hereafter, should generally be used.

The requirements for portraiture indoors are more complex. The chief of these is a head-rest. This is an instrument much abused by many; and, indeed, one that it would be good to do away with, but which, in the present condition of photographic knowledge, is still, in many cases, a necessity. The average sitter is unable to keep sufficiently steady without a rest for his head, and for his body if he be standing, during an exposure of longer than four or five seconds. Now, on consulting the Tables given further on, it will be seen that in a common room an exposure so short as this is secured only with the rapider forms of portrait lenses used with full aperture.* If a larger size than the carte, or at the most the cabinet, be attempted, it will generally be found that so large apertures cannot be used, even if the lenses be at hand, because the depth of focus given thereby is so small. As regards lens, that known as the group, or D lens, or one of the extra rapid symmetrical or rapid

* Since this was written, the sensitiveness of plates has been so much increased that, by using the rapider brands, the head-rest can generally be dispensed with, even in an ordinary room.

rectilinear, is most suitable, unless the amateur possess a portrait combination. In any case, the portrait lens is not to be recommended for sizes much above cabinet, as the depth of focus for larger sizes is so very small. For sizes above 10 by 8, even the extra rapid rectilinear is seldom available, and the ordinary "rapid rectilinear" is to be commended. Even the "single lens" may be used if the aperture be increased to "8," an aperture at which many single lenses will work (see Tables, pages 86, 87, 88); but the exposure will be somewhat prolonged.

One thing is to be particularly mentioned in connection with the lens used for portraiture, either indoors or out: *it should be one of long focus*, otherwise the most unpleasant effects of exaggerated feet, hands (or in large heads, nose)—in fact, all the parts nearest the camera—will be the result. The focal length of the lens should be not less than about double the larger dimension of the portrait to be produced. Thus, for a carte, it should not be less than 7½; for a cabinet, not less than 12 inches. If this rule be observed, the distortion given by single lenses will be quite inappreciable.

A background of some sort is a necessity. Sometimes the walls of a room are suitable; but generally it is best to make a special background. This may be done by making a light frame-work of wood, 7 feet by 5 feet, and stretching on it the coarse brown paper known as "carpet paper." This is done by damping the paper, so as to stretch it, then gluing it on the frame by the edges. Paper may be thus stretched with advantage on both sides of the frame; one side may be left the natural colour of the paper, and will do for dark backgrounds; the other may be painted of a light grey colour with "distemper," and will serve as a light background for heads to be "vignetted."

The amateur who has the necessary artistic taste and

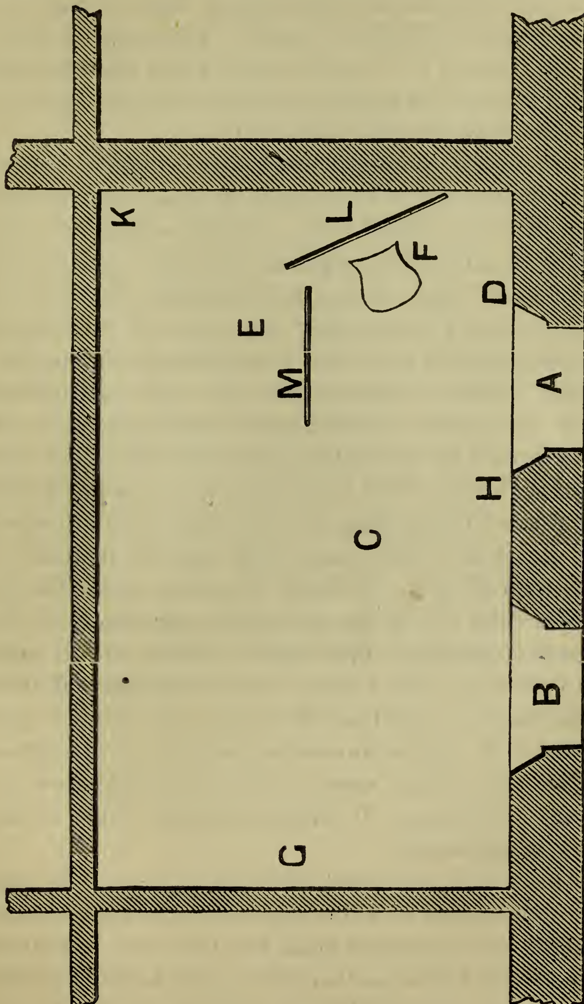
knowledge may produce scenic backgrounds to his heart's content. These are painted roughly in neutral distemper colours.

A reflector is a necessity for indoor portraiture. Its use is to relieve the heavy shadows on the side of the face that is away from the light. A sheet or table-cloth, held by an assistant, is sufficient; but a wooden frame, similar to the background, covered with white paper, is the most convenient.

The pose and lighting of the model are, of course, the chief points to which attention must be given. With regard to the first, the beginner should study well the pictures of good artists, both painters and photographers. One thing only I shall say on the matter. The so-common impression, that what the sitter is pleased to consider a free-and-easy pose will give a good result, is generally the greatest mistake possible. Nearly all photographic portraits in which there is an appearance of ease and unconstraint are the result, not of chance, but of study and intention on the part of an artistic operator.

The object to be attained in lighting is softness and roundness, avoiding on the one hand flatness, on the other harshness, such as is given if one side of the face be in too deep shadow—and to combine with this the maximum of brightness compatible with it. I shall explain how this may be obtained in any ordinary room. A sketch is here given of a room (page 75), 20 feet by 12 feet, this being a not uncommon size. At A and B are windows, each 3 feet 6 inches wide. Let us suppose the window B is closed by drawn blinds or curtains, or by closing the shutters; it is worth while noticing the various phases of lighting that may be brought about by changing the position of the sitter. Let an observer stand at C, the sitter being placed at E, and the reflector being used. It will be found that an excellent lighting, as regards quality, can be obtained, but that the quantity is so small that the exposure would be extravagantly long. Now let the sitter

be placed at D. It will be found that the lighting is bright



and bold in fact, too bold, for be the reflector used as it may,

there is too deep shade in the far side of the face, and this will be even more apparent in a photograph than to the eye. A compromise must evidently be made. This may be done by placing the sitter at F. It will now be found that the lighting will be all that can be desired, whilst the exposure will not be much greater than with the model at D.

The spot where a soft and harmonious lighting is secured being determined, the next question is, from what direction is the portrait to be taken? For pleasing results may be got with anything between three-quarter light, one-quarter shadow, and one-quarter light, three-quarter shadow, the latter style of lighting having been given the name of "Rembrandt," although the name is a bad one, as Rembrandt used lighting of every kind. With a room of the shape and size shown, the choice is not great for full-length standing figures, as the camera will have to be kept far from the sitter, and towards the end of the room. With heads, however—in which particular form of portrait the lighting is, if possible, more all-important than in any other—the camera may have its position varied anything from H to K. Probably the most successful results will be got from H. If the position be approached to K with the object of getting "Rembrandt" effects, means must be taken to shade the direct light from the window off the lens. The background, L, and the reflector, M, are shown in position for a sitter at F, and for the camera about H. It is unnecessary to say that the reflector must be kept far enough away not to appear in the picture. It should, however, short of this, be kept as near as possible.

After posing, the head-rest should be adjusted. It must be distinctly understood that this appliance is not meant as a means of clamping up the model's head, but that it is intended as a rest to be brought into position after posing has been performed, so that the sitter may gently lean his head against it.

The reason for advising that one of the windows be closed is, that a double source of light is objectionable. It is liable to produce an unpleasant lighting in general, and almost always causes a false light in the eyes.

With regard to the taking of groups, my advice is to follow as closely as possible that given by *Punch* to young men about to marry—"Don't." An amateur seldom acquires the skill necessary to enable him to pose and light artistically one figure with any degree of certainty. It is enormously more dicffiult when there are several. If groups must be done, they are best done out-of-doors. Except for carte size, a lens with comparatively small aperture must be used for groups, so as to get all the figures in focus. This makes the exposure very prolonged in an ordinary room. Moreover, some of the figures must, in such a case, be much nearer the light than others.

In grouping out-of-doors, the figures near each end of the group should be brought somewhat nearer the camera than the others, as this will bring them into better focus. Several may, with advantage, sit down slightly in advance of those standing. If the photographer can prevent all the members of the group from gazing into the camera with a glassy stare, and cause them to turn towards each other as if in conversation, he will have accomplished much.

CHAPTER X.

TABLES TO FACILITATE JUDGMENT OF EXPOSURE.*

I GAVE, in the chapter on lenses, rules whereby it is possible to compare the rapidity of various lenses, and, having once determined for a certain subject the exposure for any one lens and stop, to estimate exactly what would be the exposure with any other lens and stop. The work involved is little and easy, but

* Violent objection has been made to these Tables by several photographers of great experience and of long practice, but I retain them nevertheless. These photographers of long experience seem to think that nothing that was not of use to them at the time they learned photography—because it did not exist, or for some other reason—cannot be of use to beginners of the present day. I have, however, had so many letters describing the use that the Tables have been to the writers at that time when anything that can assist the beginner to answer that most difficult question:—"How long shall I keep the cap off the lens?" is most welcome; that, apart altogether from the fact that I composed the first three for my own use, and used them for several years, I am still pursuaded that the Tables are of some use. But I quite willingly admit—and, indeed, would emphasise the statement—that, as soon as the photographer's judgment has so far matured that he feels that he can rely on it alone, he should discard all artificial aids. I think, however, that it will generally be found that this ripening of the judgment in the matter of exposure is a thing that takes years; and, moreover, I do not find that the judgment of those who scorn such assistance as they can get from the first is by any means more quickly ripened than that of those who are willing to take advantage of it.

there are some who find even such difficult. For the sake of these I have compiled a set of Tables which, I believe, make it as nearly impossible to find any difficulty in estimating exposures as can be. I shall explain the use of them.

The Photographic Society of Great Britain has established a standard of rapidity for lenses. A lens with an aperture one-quarter its focal length ($f/4$) has been taken as the unit, and is called "1." A stop of half the area, which will necessitate double the exposure of this latter again, is called "2"; one needing double the exposure of this latter again is called "4"; and so on, 8, 16, 32, 64, 128, 256, this last being about the smallest aperture generally used in practice. Apertures larger than $\frac{1}{4}$ the focal length—which are rare—are signified by ·5, ·25. The latter is, I believe, the largest aperture possible to get in practice.

Now, it is evident that if all opticians were to adopt this standard, the estimation of exposures would be much simplified. Every stop would have on it a number signifying the rapidity of the lens when it was in use, and the same number would signify the same rapidity in the case of any lens. Moreover, the effect of using a stop one size smaller than another would always be to double the exposure.

Many manufacturing opticians have adopted the suggestion of the Photographic Society, but still a number of lenses in the market have not their stops adjusted in accordance with it. Moreover, at least one optician has adopted the standard *sizes* for his stops, but numbers them according to some scheme of his own, very different from that recommended by the Photographic Society, so that confusion is but rendered worse confounded. It is often, however, easy to alter stops so as to accord with the standard. To enable any photographer to do so who wishes, a Table is given showing for any focal length of lens what are the diameters to which it is necessary

to cut the stops. Referring to Table I., we find, for example, that with a lens of 9 inches focal length the aperture "1" will be 2·25 inches, that is, 2¼ inches. It is only possible to get such an aperture with a portrait lens, and if the lens in question be not such, we must pass on to "2"; here we find 1·59 inches still only possible with a portrait lens, with some group lenses, or with some of the new forms of extra-rapid rectilinears already mentioned. "4" we find is 1·2. This is a possible aperture with group lenses, and most modern rapid landscape lenses; the next, "1," is ·80 inches, and is an aperture to be had in all lenses of the rapid rectilinear or rapid symmetrical type. "16" is ·56 inches, and may be had in "single" lenses, and most wide-angle rectilinears or symmetricals of modern patterns; "32" is ·40, and may be had in any single lens; "64" is ·28 inch; 128 is ·20 inch; and 256 is ·141 inch.

In the case of a portrait lens, we should thus make our largest aperture 2¼ inches, and call it "1" (unless, that is, we were able to get an aperture of 3·18 inch, which we would call ·5), and the other 1·95 inches, 1·12, and so on, down as small as we pleased. In the case of a group lens, our largest stop might be 1·59, or rather more than 1½ inches. We would, however, not call this "1," because it is the first stop of this particular lens in question; but "2," because the aperture is *f*/5·657. In a single lens our largest would probably be ·56 inches, and would be marked 16. This gives the diameters to which to cut the movable stops of a lens, but the fixed stop of a lens should never be *contracted* to agree to one of the standard numbers. It should be left as it is, if it does not agree with a standard number, and should be marked with an odd number got from Table III., as will be explained.

For any lens whose focal length is *half* that of one given in the Table, the aperture must be divided by two. For one with twice the focal length of any mentioned, they must be *multiplied*

by two, for three times by three, and so forth. It is thus possible, by mere reference to the Table I., to cut a set of stops to the standard sizes for any lens.

We now take Table II. This needs no great explanation. In it will be found the necessary exposures for most subjects with all standard apertures of the Photographic Society.

Table III. is not quite so readily understood. I have explained how to cut a set of stops to the standard sizes for any lens, but it is quite possible that some may not have the inclination to do so, or the means therefor. For such this Table is intended. Anyone can, by its use, take any lens, and by merely measuring the stops, say what relation there is between the area of each one, and of such a stop as would form the Great Britain Society's unit.

Let us take an example. I suppose once more that we have a portrait lens of 9 inches focal length, and that we do not wish to make a new set of stops, but that we wish to find out for each stop what ratio its area bears to one that would form the unit of the Great Britain Society's standard stops, or, in other words, would measure in diameter one-quarter the focal length of the lens, and would be styled "1," or *f*/4. Say the full aperture of the lens is 2½ inches, and the other stops 2 inches, 1½-inch, 1-inch, and ½-inch. On the Table, opposite 9 inches focus and 2½-inch aperture, we find ·81, that is to say, the lens will require an exposure of ·81, or about four-fifths of a second, where one working with an aperture "1," or *f*/4, will take one second.

Opposite 2 inches in the same line we find 1·24. With this stop the exposure will be 1·24, or (say) one and a-quarter times as long as with a lens working *f*/4. The figures opposite the other apertures mentioned are 2·28, 5·06, 20·25. With these stops the lens will need exposures 2·28, 5·06, and 20·2 times as long as will a lens working *f*/4, which, as has already been mentioned, is said to have the aperture "1."

I shall now explain the working of Tables III. and II. together, by taking a set of examples.

Let us suppose that we have a single landscape lens of 8 inch focus, that the subject we are about to photograph is a landscape with deep shadows and dark foreground, and that the stop which, out of those with which the lens is provided, gives the best result is $\frac{1}{4}$-inch diameter. In Table III. we find opposite 8-inch focal length, and under $\frac{1}{4}$-inch aperture, "64." We now turn to Table II. Opposite "64" (or $f/32$) we find for landscape with heavy foliage in the foreground 8 seconds. This, therefore, is the exposure which we have to give.

Again, suppose the lens and subject the same, but the aperture only $\frac{3}{16}$-inch. We find in Table III., opposite 8 inches focal length and under $\frac{3}{16}$-inch, "114." Now we will not find any such aperture as "114" in Table II., that number not being one of the standard ones. The nearest we can find is "128," which is somewhat too large. We find opposite it an exposure for landscape, with heavy foliage in the foreground, 16 seconds. Strictly speaking, we ought to work out a proportion sum thus :—128 : 114 : : 16 seconds : the exposure needed, which we will find to be 14·5 seconds. In practice, of course, there is no need of any such accuracy; we simply notice that as the aperture is somewhat larger than the standard one, the exposure will therefore be a little shorter.

Yet another example. Suppose a "rapid" landscape lens, focus 10 inch, stop $\frac{7}{8}$-inch, to be in use, the subject a portrait out of doors. In Table III. we do not find $\frac{7}{8}$-inch among apertures. Let us take the nearest on each side of this—namely, $\frac{3}{4}$-inch and 1 inch. We find under $\frac{3}{4}$-inch 11·1, under 1 inch 6·25. Now neither of these figures is to be found as a standard aperture in Table II., but lying between them, as $\frac{7}{8}$-inch lies between $\frac{3}{4}$-inch and 1 inch, is the standard number "8." It will be quite near enough to take the aperture as this, and

to take the exposure which we find opposite it—namely, 1 second.

Another thing must be mentioned. In case of portraits, when large heads are done, or in any case where subjects very near the lens have to be taken, the camera has to be drawn out to a considerable distance, possibly several inches. The focal length of tho lens is, in fact, increased for the particular subject. This has to be taken into account in judging of the exposure.

We shall take an example of this. Let us suppose a 12-inch focus portrait lens used with an aperture of 2 inches, the subject being a portrait indoors. We find that this aperture is, according to Table III., 2·25; the exposure will therefore be somewhat more than that opposite "2" in Table II. This, for a portrait indoors, we find to be 6 seconds; we would therefore require (say) 7 seconds.

Let us suppose, however, a head one-third life-size to be attempted. It will be found that the camera has to be extended till the focus is 16 inches. Referring to Table III., we find that with a lens of 16 inch focus, 2 inches aperture is equal to standard number "4," and, referring to Table II., we find that an exposure of 12 seconds will now be needed.

Table No. IV. was compiled by Dr. J. A. Scott, who communicated it to the Dublin Photographic Society. It works in conjunction with Table II. The exposures in Table II. are for the very best light—that is to say, for that of the middle of the day in May, June, or July. Table IV. shows by how much it may be necessary to multiply the exposure given in Table II. for any hour any month of the year.

I shall explain the working of these two Tables together.

We are about to photograph an open landscape at five o'clock on an August afternoon; the lens we are using is a single achromatic, and we are working with stop No. 128, or *f*/44·25.

In Table No. II. we find in the column headed "open landscape," and in the line beginning 128, two seconds. Now, referring to Table IV., we find in the column headed "April or August" (the exposures being the same for either of these months), and in the line beginning 7 or 5 (that is to say, 7 a.m. or 5 p.m., at both which hours the light is the same), the figure 3. This means that the exposure found in Table II. is to be multiplied by 3. We found in Table II. 2 seconds—$2 \times 3 = 6$; therefore, six seconds is the exposure to be given.

It must be understood that Table II. is only approximate. Thus plates vary considerably in sensitiveness. The Table exposures will be found suitable for most plates that are sold under such names as "ordinary" or "landscape," whilst the quickest plates commonly met with in the market will need exposures of only from one-third to one-fifth those in the Tables. I have, of late years, occasionally come across plates that would work with one-tenth of the table exposures, but they are quite exceptional. Again as to subject. Very often subjects do not come precisely under the headings given. For example, landscapes most often come somewhere between such as are described in the second and third columns. By an open landscape is meant such a subject as shows broad exposures of sunlight without any deep shadows near the camera. River scenes with trees in the distance, roads and houses without trees, and such like, come under the heading.

By the "interiors" is meant such subjects as cathedrals and churches. They need very careful treatment, as there is likely to be a greater range of light than can well be registered by a photographic film.

With regard to "portraits in ordinary rooms," I explained that, under the most propitious circumstances, the exposures may be reduced to half those given, which are on the assumption of an average-sized window, without houses or trees

opposite it.* If there be opposite the window anything to obscure much of the sky, the exposure will have to be greatly protracted.

No rule can be given for exposures in dull and foggy weather; but it may be said that they often need to be much more protracted for such than the beginner would at first imagine.† On the other hand, there is a certain diffused light when the sun's rays reach the earth after passing through a large area of thin fleecy clouds in which the exposures are remarkably short, often as short, or nearly as short, as with the most brilliant sunshine.

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* With the rapidest plates, and a very large window, I have known it to be reduced to $\frac{1}{10}$th or even $\frac{1}{20}$th the figures given. With the modern very rapid plates of the market, the exposures will be about $\frac{1}{5}$th those given.

† For the convenience of photographers, the Tables, and most of the general information contained in this chapter, have been put into a compact form, along with space for notes, in a pocket-book entitled "Burton's Note-Book for Photographers." 9d. and 1s. Messrs. Piper and Carter, 5, Furnival Street, Holborn.

TABLE I.

Focal Length / Standard No.	6 ins.	6½ ins.	7 ins.	7½ ins.	8 ins.	8½ ins.	9 ins.	9½ ins.	10 ins.	11 ins.
·25	3	3·25	3·5	3·75	4	4·25	4·5	4·75	5	5·5
·5	2·12	2·3	2·47	2·65	2·82	3·01	3·18	3·36	3·53	3·89
1	1·5	1·62	1·75	1·87	2	2·12	2·25	2·37	2·5	2·75
2	1·06	1·15	1·23	1·32	1·41	1·50	1·59	1·68	1·77	1·94
4	·75	·81	·87	·93	1	1·06	1·12	1·18	1·25	1·37
8	·53	·57	·62	·66	·71	·75	·80	·84	·88	·97
16	·37	·40	·44	·47	·5	·53	·56	·59	·62	·69
32	·26	·28	·31	·33	·35	·38	·40	·42	·44	·49
64	·188	·20	·22	·23	·25	·26	·28	·29	·31	·34
128	·132	·144	·155	·168	·177	·188	·20	·21	·22	·24
256	·094	·101	·109	·117	·125	·133	·141	·148	·156	·172

TABLE II.

Apertures calculated on Standard System of Photo. Society.	Sea and Sky.	Open Landscape	Landscape with Heavy Foliage in the Foreground	Under Trees, up to		Fairly Lighted Interiors		Badly Lighted Interiors up to		Portraits in Bright Diffused Light out of doors	Portraits in Ordinary Rooms	
·25, or $\frac{f}{2}$ ...	secs. $\frac{1}{640}$	secs. $\frac{1}{240}$	secs. $\frac{1}{32}$	mins. 0	secs. $2\frac{1}{2}$	mins. 0	secs $2\frac{1}{2}$	hrs. 0	mins. $\frac{1}{2}$	secs. $\frac{1}{32}$	mins. 0	secs. $\frac{3}{4}$
·5, or $\frac{f}{2 \cdot 828}$ ...	$\frac{1}{320}$	$\frac{1}{120}$	$\frac{1}{16}$	0	5	0	5	0	1	$\frac{1}{16}$	0	$1\frac{1}{2}$
·1, or $\frac{f}{4}$ ...	$\frac{1}{160}$	$\frac{1}{60}$	$\frac{1}{8}$	0	10	0	10	0	2	$\frac{1}{8}$	0	3
2, or $\frac{f}{5 \cdot 657}$ ...	$\frac{1}{80}$	$\frac{1}{30}$	$\frac{1}{4}$	0	20	0	20	0	4	$\frac{1}{4}$	0	6
4, or $\frac{f}{8}$ ...	$\frac{1}{40}$	$\frac{1}{15}$	$\frac{1}{2}$	0	40	0	40	0	8	$\frac{1}{2}$	0	12
8, or $\frac{f}{11 \cdot 314}$ ...	$\frac{1}{20}$	$\frac{1}{8}$	1	1	20	1	20	0	16	1	0	24
16, or $\frac{f}{16}$ ...	$\frac{1}{10}$	$\frac{1}{4}$	2	2	40	2	40	0	32	2	0	48
32, or $\frac{f}{22 \cdot 627}$	$\frac{1}{5}$	$\frac{1}{2}$	4	5	20	5	20	1	4	4	1	36
64, or $\frac{f}{32}$ ...	$\frac{2}{5}$	1	8	10	40	10	40	2	8	8	3	12
128, or $\frac{f}{44 \cdot 2}$	$\frac{4}{5}$	2	16	21	0	21	0	4	16	16	6	24
256, or $\frac{f}{64}$	$1\frac{1}{4}$	4	32	42	0	42	0	8	22	[illegible]	12	48

A, portrait lenses; B, rapid view lenses; C, landscape lens.

TABLE III.

Ins. Diam.	1/16	3/32	1/8	3/16	1/4	3/8	1/2	5/8	3/4	1	1¼	1½	1¾	2	2¼	2½	3	3½	4	4½	5
3 ins.	144	64	36	16	9	4	2·25	1·44	1	·562	·36	·25									
3½	196	87·1	49	21·8	12·2	5·45	3·06	1 ·6	1·36	·766	·49	·34	25								
4	256	114	64	28·4	16	7·11	4	2·56	1·78	1	·64	·444	·326	·25							
4½		146	81	36·5	20·2	9·12	5·06	3·24	2·28	1·26	·81	·57	·413	·316	·25						
5		178	100	44·4	25	11·1	6·25	4	2·78	1·56	1	·694	·51	·39	·309	·25					
6		256	144	64	36	16	9	5·76	4	2·25	1·44	1	·738	·562	·444	·36	·25				
7			196	87·1	49	21·8	12·3	7·84	5·4	3·06	1·96	1·36	1	765	·605	·49	·34	·25			
8			256	114	64	28·4	16	10·2	7·11	4	2·56	1·78	1·3	1	·790	·64	·444	·326			
9				146	81	36·5	20·2	13	9·12	5·06	3·24	2·28	1·65	1·24	1	·81	·57	·413			
10				178	100	44·4	25	16	11·1	6·25	4	2·78	2·04	1·56	1·23	1	·694	·510			
11				215	121	53·8	30·2	19·4	13·4	7·56	4·84	3·38	2·47	1·89	1·49	1·21	·845	·617			
12				256	144	64	36	23	16	9	5·76	4	2·95	2·25	1·78	1·44	1	·738	·562		
13					169	75·1	42·2	27	18·8	10·6	6·76	4·69	3·45	2·64	2·09	1·69	1·17	·863	·66	·521	
14					196	87·1	49	31·4	21·7	12·2	7·84	5·4	4	3·06	2·42	1·96	1·36	1	·765	·605	
15					225	130	56·2	36	25	14	9	6·25	4·59	3·51	2·78	2·25	1·51	1·15	·878	·694	
16					256	114	64	41	28·4	16	10·2	7·11	5·21	4	3·16	2·56	1·78	1·3	1	·79	
18						146	81	51·8	36·5	2·2	13	9·12	6·61	5·06	4	3·24	2·28	1·65	1·24	1	·81
20						178	100	64	44·4	25	16	11·1	8·16	6·25	4·94	4	2·78	2·04	1·56	1·23	1

TABLE IV.

Hour of Day. A.M. P.M.	June	May or July	April or Aug.	Mar. or Sept.	Feb. or Oct.	Jan. or Nov.	Dec.
12	1	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$3\frac{1}{2}$	4
11 or 1	1	1	$1\frac{1}{4}$	$1\frac{1}{2}$	$2\frac{1}{2}$	4	5
10 or 2	1	1	$1\frac{1}{4}$		3	5	6
9 or 3	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	4	12	*16
8 or 4	$1\frac{1}{2}$	$1\frac{1}{2}$	2	3	*10	—	—
7 or 5	2	$2\frac{1}{2}$	3	*6	—	—	—
6 or 6	$2\frac{1}{2}$	*3	*6	—	—	—	—
5 or 7	*5	*6	—	—	—	—	—
4 or 8	*12	—	—	—	—	—	—

* The accuracy of these figures will be affected by a yellow sunset.

CHAPTER XI.

SECOND LESSON IN DEVELOPMENT.

In considering the subject of exposure in a former chapter, we assumed that correct exposure is a fixed point, and that any deviation from it would give imperfect results. This is scarcely the case, however, for there is a certain "latitude," which is due to two causes: first, a certain latitude of *effect* is permissible. Thus, if the plate be a little under-exposed, there will be somewhat less detail in the resulting picture than is visible to the eye; but this need not altogether spoil it. Again, if the plate be somewhat over-exposed, the effect will be a slight fog or want of transparency in the shadows of the negative; but the only result of this will be that what is called a "slow printing" negative is produced. The latitude in effect is not great, however. It may be said that if two seconds be the best exposure, anything between one and a-half and three, or perhaps four, seconds will give good results without modify- the developer. We have, however, a second method of gaining latitude, and this is by means of the treatment with the developing solutions. Thus, with any developer, simply by leaving the plate for a longer or shorter time in the solution, we can compensate to a certain extent for under or over-exposure. It is, however, by varying the proportions of the ingredients of the alkaline developer that we gain the greatest latitude.

The essentials of this developer are as follows:—First, pyrogallic acid, or more properly, pyrogallol; and, second, carbonate of potash, liquid ammonia, or some other alkali.

With pyrogallic acid and an alkaline carbonate only in solution, it is quite possible to conduct development; but a soluble bromide, generally bromide of ammonium or of potassium, is used at times along with these to more completely control the action, and such is indeed essential where ammonia is the alkali used. It is also, now, an almost universal custom to have a certain quantity of sulphite of soda (first introduced by Mr. Herbert Berkley), or of meta-bisulphite of soda (first introduced by Swan) in the developer, as such prevents the rapid darkening by absorption of oxygen from the air, and consequent staining of the negative that is otherwise liable to take place. If the sulphite, or meta-bisulphite, be mixed up with the pyrogallic acid as recommended in the description of "stock solutions" in the beginning of this book, the result is a very convenient concentrated solution that will keep, ready for use at any time, for several months.

The pyrogallic acid is the true developer, and acts very energetically when rendered alkaline. The stronger the developer is in pyrogallic acid—up to a certain point, at any rate—the denser or more opaque will be the negative; and, as a consequence, the stronger will be the contrast between light and shade in the resulting print.

The carbonate of potash, or other alkali, is used to render the developer alkaline, and the greater the quantity in the solution, the more energetic the action. The effect of increasing the alkali is to shorten greatly the time of development, to increase to a slight extent the amount of detail, and, up to a certain point, to increase the density. A point is reached, however, where the action is so energetic as to reduce or blacken even those parts of the plate which have not been acted on by light,

and fog is the result. Some plates will stand much more alkali than others.

The use of the bromide is to retard development—to make it slower, so that it may be more under control. A developer with carbonate of potash or of soda is comparatively slow, even without any bromide, and the latter is, therefore, not needed in normal circumstances; but with ammonia the action, without any bromide, is so rapid as to be quite beyond control. The result of increasing the bromide is to make the developer much slower, to keep back a little of the detail, and to increase ultimate density greatly.

The function of the sulphite of soda is merely to prevent discolouration of the solution, and consequent staining of the negative. In moderate quantities it may be said that it is quite neutral as concerns the actual development, but, if used in too great quantity, it tends to reduce the opacity of, or contrast of, the negative. The citric acid given in the stock solution of pyrogallic acid (Chapter II.) is used merely to insure the neutrality, or rather the non-alkalinity, of the sulphite of soda, a salt which is nominally neutral as sold, but that is very often, as a matter of fact, somewhat alkaline. If it is in this condition, it does not perform its function of preserving the pyrogallic acid solution efficiently. Any of various other acids besides citric acid may be used.

A little consideration of what has been said will show that by varying the proportions of the constituents enumerated, we have the power of greatly modifying the resulting negative, and have a power of compensating, to a considerable extent, for error in exposure. This is especially the case for over-exposure. It is true that in the case of under-exposure we can correct, to a certain extent, by using an increased quantity of alkali; but the fog point is soon reached, and thus it is only slightly that we can correct in this direction. In the case of

over-exposure, however, it is different; bromide may be added indefinitely. By using a large quantity of bromide the development is rendered slow as regards the appearance of detail, but less so as regards the increase of density. It is thus possible to stop the process in the case of an over-exposed plate before the shadows veil over, and yet to have a sufficiently dense negative.

It is right, in using any particular make of plates, to use the developer recommended in the "instructions"; but it is by no means necessary to mix the "stock solutions" exactly as directed. On analysing any of the sets of stock solutions given, it will be found that they consist essentially of the chemicals mentioned before, made up in solutions of certain strengths, and nearly always with some preservative—generally sulphite of soda, in the case of the pyrogallic solution—to prevent its turning brown by oxidation. In almost every case there is a most needless complication introduced, which makes considerable calculation necessary to find what quantity of each chemical really is in an ounce of the final developer. There can be no simpler plan than to mix all solutions used for development so that each shall contain ten per cent. of one of the ingredients; the mixture of pyro, sulphite of soda, and a little acid being looked on as a ten per cent. solution of pyrogallic acid only. Any developer can then be made up in any proportion without trouble, and that given in any instructions can be used without the intervention of complicated formulæ. At the end of the chapter there is given a very useful table compiled by Messrs. Lyonel Clark and E. Ferrero, showing at a glance the actual proportions of the ingredients recommended as developers by different plate manufacturers (see pages 98, 99; the quantities are given in grains and minims per ounce of developer).

To carry out the development of all kinds of plates exposed on all kinds of subjects, it is necessary to have, in addition to

the stock solutions mentioned in Chapter II., only a ten per cent. solution of bromide of potassium. This is made by taking one ounce of bromide of potassium, and making up the quantity to ten ounces with water.*

There is no developer that is suitable for all subjects. Those given in instructions can only be taken as typical. If the photographer expect to excel, he must vary his developer to suit his subject. Thus, when the contrasts in the object to be photographed are very strong—say in the case of an interior with white columns and deep shadows—he must reduce the amount of pyro, or he will have a negative giving a "chalky" print.

If the contrasts are naturally weak, as is sometimes the case in open landscape, he must increase the quantity of the pyro, and perhaps add a little bromide. If he know that he has under-exposed, he must increase the alkali. If he know that he has over-exposed, he must increase the bromide.

The developer given in Chapter V. is somewhat weaker in alkali than is generally recommended, and is, consequently, rather a slow developer. The slowness is a decided advantage, at least at first. There are many who prefer at all times to use but little alkali, allowing the image to develop very slowly, the reason being that they believe that they thereby get a higher quality of negative in the end. There can be no doubt, however, that with most plates, and when the photographer is certain that his exposure is correct, it is permissible to use considerably more alkali even from the first. The following may be taken as a normal developer for average subjects, when correctly exposed, on most kinds of plates:—

Ten per cent. solution of pyrogallic acid ...	20 to 25 minims
Ten per cent. solution of carbonate of potash	100 ,,

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* Bromide of potassium	50 grammes
Water to make up to	500 c.c.

To each ounce of developer needed.*

The time taken for development with this developer will be only two-thirds or three-quarters of that with the developer given in Chapter V.

If, as is generally the case in landscape work—at least, in the case of the first plate developed of a number that have been exposed at the same time—there is uncertainty as to whether the plate has been exposed correctly or not, it is best to begin with a developer very weak in alkali, and to add more afterwards if it appear to be needed. The following is the sort of developer that should be first flowed over a plate when there is uncertainty of the kind mentioned:—

Ten per cent. solution of pyrogallic acid	20 to 25 minims
Ten per cent. solution of carbonate of potash	30 ,,

To each ounce of developer needed.†

This is a very slow developer, and even if the plate be much over-exposed, the image will not appear for some time. A little experience will enable the photographer to know, by the length of time which elapses between the time of pouring on the developer and the appearance of the image, and by noticing how the detail begins to come up, whether the plate has been over-exposed, correctly-exposed, or under-exposed. If the exposure appears to be correct, ten per cent. solution is added a little at a time (say 20 minims) till the detail is all out. The

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* Ten per cent. solution of pyrogallic acid	2 c.c.
Ten per cent. solution of carbonate of ammonium ...	10 c.c.
Water to make the solution up to	50 c.c.

† Ten per cent. solution of pyrogallic acid	2 c.c.
Ten per cent. solution of carbonate of potash ...	3 c.c.
Water to make the solution up to	50 c.c.

addition is best made by pouring the additional potash solution into the developing cup, pouring the developer from the dish back into the cup, when thorough mixture takes place, and again over the plate.

If it appeared to be over-exposed, development is proceeded with, or even, in an extreme case, some bromide of ammonium —say ten minims of the ten per cent. solution to each ounce of developer—is added. If the image be very long in appearing, showing that there has been under-exposure, alkali may be added to any amount short of that which will produce fog. Good plates should stand 200 minims to the ounce of ten per cent. of carbonate of potash without fogging.

A few words should be said on the development of plates that have received instantaneous exposures, and on which portraits have been impressed.

In the case of most subjects that are suitable for instantaneous work, the brightness of the object is very great, but the *contrast* of light and shade is often comparatively small, as even the shadows reflect a good deal of light. For this reason there is sometimes great difficulty, not only in getting detail in the shadows, but also in getting density. The thing necessary to get both is great patience in continuing development for a very long time with a very slow developer; that is to say, one in which the quantity of alkali is rather below than above the normal quantity, and that of the pyro somewhat high.

The dish must be rocked at least every ten seconds or so during the development, which may often with advantage be continued for a quarter or even half an-hour.

When development is protracted for a very long time, the dish should be covered to protect it from light, except when it is necessary to look at the plate.

Concerning portraits, I may say that for the development of those taken out-of-doors, no particular precaution is necessary.

In those taken in an ordinary room there is always a tendency to hardness or chalkiness, and for this reason it is generally well to keep the pyro somewhat below the normal.

It used to be commonly said that there is difficulty with gelatine plates in getting a dense enough image. Where good plates are used, such a difficulty results only from ignorance of the principles of development. The secret of getting "plucky" negatives lies in plenty of patience, beginning only slowly with but a small quantity of alkali, and if we are at all doubtful about getting sufficient density, in giving, perhaps, a slightly longer exposure than might otherwise be thought necessary. The real difficulty lies in judging when the density is great enough.

On the two following pages is printed the table referred to on page 93, showing the actual proportions of the ingredients recommended as developers by different plate makers; the quantities being given in grains and minims per ounce of developer.

PLATES.	Pyro.	Ammonium Bromide.	Potassium Bromide.	Ammonia.	Sodium Carbonate.	Potassium Carbonate.	Ammonium Carbonate.	Sodium Sulphite.	Potassium meta-bisulphite
	Grains.	Grains.	Grains.	Minims.	Grains.	Grains.	Grains	Grains.	
Abney and Derby	2	2 to 4	...	1·60 to 4	...	...	...	...	...
Ditto	3·60	...	...	...	...	22	...	18·80	...
Academy	2	2	...	4	...	...	...	...	...
Albert	1·50	0·63	...	3·16	...	...	...	...	...
Beechey (Dry Collodion)	12	...	3	...	...	...	30	...	...
Beernaert	4·78	...	...	...	16·05	...	...	32·10	...
Britannia	2	2	...	4	...	...	...	...	...
Cadett's	1·50	3	...	6	...	...	...	...	...
Charterhouse	1·36	3·40	...	1·36	...	...	...	2·72	...
Cranbourne	1·10	...	0·72	2·30	...	...	...	4·40	...
Derby	2	2 to 4	...	1·60 to 4·00	...	...	...	...	...
Derwent...	2·18	...	...	...	14·4	...	...	38·4	...
Eastman's Paper Negative	4·50	...	...	...	19	...	...	27	...
Eastman's Stripping Film	4·50	...	...	...	19	...	...	27	...
Ditto Ditto	3·53	...	...	...	12	3	...	21·18	...
Ditto Ditto (NH_3)	2	0·50	...	3	...	...	...	...	...
Edwards's XL	2·10	...	0·50	2	...	...	...	...	2
England's	1·50	...	1	2	...	...	...	...	...
Ditto, Instantaneous	3·40	...	...	...	...	8·60	...	17	...
Elliott and Fry's	2	0·30	...	1 to 1·30	...	...	...	...	...
Elliott's	3	1	...	3	...	...	...	...	...
Ditto, Extra Special	2	1	...	3	...	...	...	...	...
Ditto, Dragon	2	2·80	...	3·75	...	...	...	...	...
Facilis	2	2·50	...	4·50	...	...	...	...	...
Froedman's Tissue	3·33	...	...	...	...	8·75	...	22	...
Fry's German (Dr. Eder's)	2	...	0·57	2	...	...	...	...	...
Ditto, Kingston, Special ...	2	0·71	...	2	...	...	...	...	...
Ditto, Ditto, Instantaneous ...					...	...	...	...	...
German (Sands and Hunter) ...	2·14	...	0·23	0·26	...	...	...	...	...
Globe	2	1	...	4	...	...	...	...	...
Ilford	1·85	2·50	...	4·50	...	...	...	...	...
Keystone	2·50	...	...	...	...	6·41	...	10	...
Lancaster's	2·40	...	0·83	5	...	...	...	...	...

PLATES.	Pyro.	Ammonium Bromide.	Potassium Bromide.	Ammonia.	Sodium Carbonate.	Potassium Carbonate.	Ammonium Carbonate.	Sodium Sulphite.	Potassium meta-bisulphite
	Grains.	Grains.	Grains.	Minims.	Grains.	Grains.	Grains.	Grains.	
Ludgate	2·14	...	0·23	1·87	...	...	...	...	...
Manchester, No. 1	2	Bromide to	Ammonia	as 1 is to 4	...	...	...	...	...
Ditto, No. 2	2	1·50	0·75	3	...	...	...	6	...
Ditto, No. 3 Sulp.-Pyro ...	2	0·90	0·46	1·80	...	...	...	...	...
Ditto, No. 4 ditto (Potash) ...	2	...	0·12	...	...	4	...	...	...
Ditto, No. 5 ditto (Soda) ...	2	...	0·12	...	4	...	...	...	...
Mawson and Swan's	1·50	0·75	...	3·75	...	...	...	...	1·50
Ditto, New Cheap	1·50	1·50	...	3·75	...	...	...	...	...
Ditto (Soda)	1	...	0·50	...	14	...	...	21	...
Do., Photo-Mechan. & Lantern	1·50	0·75	...	3	...	...	...	...	1·50
Mawdsley	1·50	...	0·50	3	...	...	...	...	...
Mayfield's Special Favourite ...	3·40 to 5·10	...	...	...	...	12 to 30	...	21·60 to 40·40	...
Miall's	3	0·25 to 0·50	...	2·50 to 4	...	...	...	...	...
Midland...	2	0·20 to 0·40	...	0·60 to 4	...	...	...	...	...
Monckhoven's...	1·25	1·50	...	2 to 4	...	...	...	...	...
Morgan and Kidd's	2	0·25	...	1	...	...	...	...	...
Ditto, Richmond...	2 or more	0·20 or more	...	0·83 or more	...	...	...	...	...
National	2·50	...	1·50	2·30	...	...	...	...	...
Nelson	2	2·90	...	11·33	...	...	...	...	...
Obernetter	0·80	...	0 20 to 0·50	...	7 to 10	...	...	40	...
Paget's	1·82	0·45	...	2·50	...	...	...	7·29	...
Premier	2	2·50	...	3	...	...	...	...	...
Rouch's...	1·26	1·26	...	3	...	...	...	5·04	...
Soho	1·90	1·25	...	2·25	...	...	...	...	...
Thomas's	1·08	1·08	...	2·40	...	...	...	4·32	...
Ditto (Potash)	2·25	0·11	...	...	...	9·37	...	6·75	...
Trafalgar	1	...	1	1·30	...	...	...	...	...
Vogel (Obernetter) Azaline Plates	1	...	...	...	7·50 to 11·25	...	...	50	...
Wratten & Wainwright's Ordinary	2	...	0·33	2·50	...	...	...	...	...
Wratten & Wainwright's Instant.	3	...	0·33	2·50	...	...	...	...	...
Wratten & Wainwright's Special Drop-Shutter	3	...	0·62	2·50	...	...	...	...	...
Wratten & Wainwright's (Soda)...	3	...	...	...	18	...	...	...	...

CHAPTER XII.

VARIOUS OTHER DEVELOPERS IN USE.

The Ammonia Developer.—A developer in which the alkali is ammonia was that by far the most generally used in England until within the last three or four years, and there are still many who prefer ammonia to the alkaline carbonates. It has, indeed, the advantage that development can be finished with great rapidity, and that is an unmistakable advantage in the case of a professional portrait photographer, but is of little or none in the case of an amateur. There are also, perhaps, some plates that give more detail with ammonia than with any other alkali, but such is certainly not the general rule. On the other hand, ammonia has the distinct disadvantage of producing colour fog (for a description of which see next chapter) with some plates, and especially if the attempt be made to force development in the case of under-exposure.

The following will be found to be a good developer for general work:—

Ten per cent. solution of pyro ...	10 to 20 minims
Ten per cent. mixture of ammonia and water	25 ,,
Ten per cent. solution of bromide of ammonium	10 ,,

To each ounce of developer needed.*

* Ten per cent. solution of pyro	1 to 2 c.c.
Ten per cent. mixture of ammonia and water ...	2 to 3 c.c.
Ten per cent. solution of bromide of ammonium	1 c.c.
Water to make the whole quantity up to ...	50 c.c.

The ten per cent. solution of pyro may be the same as that used with potash, or may simply be made up as follows:—

Pyrogallic acid	1	ounce
Citric acid	¼	„
Water to make the solution up to ...	10	ounces*

If the latter be used, the negatives got will not, as a rule, be black, but of a brownish colour that does not look very well, but that has excellent printing qualities.

The ten per cent. mixture of ammonia and water is made by taking one ounce of the strongest ammonia, or two ounces of the ammonia diluted with an equal quantity of water as recommended in Chapter II., and making up the quantity to ten ounces.

The Soda Developer.—The action of carbonate of soda in the alkaline developer is very similar to that of carbonate of potash, but that it makes a somewhat slower developer if the same quantity only is used, and that it tends, on the whole, to give denser negatives. It may be used in precisely the same way as the potash, a ten per cent. solution of common washing soda being made up. This should be used in quantities nearly double those recommended for the potash solution. Indeed, I have known plates that would stand development with a mixture made up of the stock solution of pyro and a ten per cent. solution of carbonate of soda without further dilution.

I have found common washing soda to be quite satisfactory in its action, in spite of the fact that, as there is liable to be a variation in the quantity of water of crystallization, it is not possible to have a solution of absolutely fixed strength. Some prefer, on this account, to use the anhydrous carbonate of soda, which has no water of crystallization. If a ten per cent. solution of this be used, it should be borne in mind that it is a

* Pyrogallic acid...	40 gr.
Citric acid	10 „
Water to make the solution up to	400 c.c.

little more energetic in development than a ten per cent. solution of carbonate of potash, and that, therefore, rather *less* of it should be used.

The Hydroquinone Developer.—This developer, which was introduced by Abney some years ago, has of late become a great favourite with many. Its action is similar to that of pyro, but it is not so liable to stain, and it gives a negative with very clear shadows and of a beautiful black colour of deposit. There is no doubt, too, that in the case of some* plates, more detail can be got out with hydroquinone than with pyro. A great stimulus was given to the use of hydroquinone by the publication of a paper on the subject by Mr. J. W. Swan, in 1889. In that paper he first suggested the use of caustic alkali with the substance. The following is the exact developer that he recommends for normal exposures :—

Hydroquinone	2 grains
Sulphite of soda	6 ,,
Citric acid	¼ grain
Caustic potash	6 grains
Bromide of potassium	¼ grain

To each ounce of developer needed.†

* A great deal of the difference of opinion that exists as to which is the best developer arises from not taking into consideration the fact that what is the best developer for one kind of plate is not by any means of necessity the best for all kinds. This conclusion is the result of many comparative experiments. As an example, I prefer pyro to any other developer in most cases, but I know of plates *that will not give even a fairly good negative with pyro* that will, nevertheless, give excellent results with hydroquinone.

† Hydroquinone	·8 grain
Sulphite of soda	2·5 grains
Citric acid	·1 grain
Caustic potash	2·5 grains
Bromide of potassium	·1 grain
Water to make the solution up to	200 c.c.

This developer is very rapid in its action, and gives fine black-coloured negatives. Of late several "one-solution developers"—that is to say, solutions that need nothing but dilution with water to make active developers—have been in the market, and have found favour with many. Several of these are hydroquinone developers. The writer does not approve greatly of "one-solution developers," as he considers that they do not allow the same latitude in either exposure or effect as do those so mixed that the quantities of the constituents can be varied at will. Still, such developers are so convenient in many ways that they are greatly used. The following will be found to be as good as any hydroquinone "one-solution developer" that there is:—

Hydroquinone	1 ounce
Sulphite of soda	8 ounces
Yellow prussiate of potassium ...	1 ounce
Caustic soda	2 ounces
Water up to	20 ounces*

This developer, diluted with ten parts of water, is extraordinarily energetic in its action. Diluted with twenty to twenty-five parts of water, it still develops with fair rapidity. The image got with this developer is excellent in colour, and there is no difficulty in getting density. In the case of some plates it is undoubtedly possible to get a little more detail than with pyro, or, perhaps, to speak more correctly, the finer detail got has greater printing density with this developer than with pyro. This means that it is a better developer for instantaneous work, or any other work where it is wanted to give the briefest

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* Hydroquinone	50 grains
Sulphite of soda	400 ,,
Yellow prussiate of potash...	50 ,,
Caustic soda...	100 ,,
Water up to	1 litre

possible exposure; but here, as in many other cases, there is a tendency to mistake mere rapidity of action of the developer for the power to bring up more detail.

Hydroquinone may be used with carbonate of potash or carbonate of soda, simply using hydroquinone instead of pyro. Those who wish to work with hydroquinone and a carbonate may take the formulæ given in the last chapter, simply replacing pyro with hydroquinone. One thing is to be observed, however, and that is that it is not possible to make a ten per cent. solution of hydroquinone, as it is not sufficiently soluble. It is, however, possible to make a five per cent. solution in the following manner. An ounce and a-half of sulphite of soda, and one drachm of citric acid, are dissolved in enough water to make up about nine ounces. To this there is then added one-half ounce of hydroquinone, and the whole is stirred till solution takes place, gentle heat being applied if any difficulty is met with.* This five per cent. solution must, of course, be used in just double the quantities recommended for the ten per cent. solution of pyro.

This developer will be found to be slow in its action, but gives beautifully coloured negatives with very clear shadows. It is a particularly useful developer where there is difficulty in otherwise getting sufficient density.

Eikonogen.—This developer was introduced in 1889, and immediately produced a great sensation. It was claimed for it that it would permit of good negatives with a much shorter exposure than was possible with any other developer, that it gave a better colour of negative, and that it did not stain the hands or anything else. In my experience it allows of a *very little*

---

* Hydroquinone	30 grains
Sulphite of soda	90 „
Citric acid	4 „
Water to make the solution up to	600 c.c.

shorter exposure than most developers, and certainly gives a good colour of negative, though not, I think, better than that given by hydroquinone. It is certainly, when mixed with sulphite of soda, an extremely cleanly developer, with apparently no tendency at all to stain.

The substance is used in the same way as pyro, but two or three things must be closely observed. In the first place, it is necessary to use much more eikonogen than would be necessary in the case of pyro. In the second place, ammonia may not be used as an alkali, as it produces colour fog; and, in the third place, if a restrainer is needed, it should not be bromide of ammonium, which is permissible with any other developer, but either bromide of potassium or bromide of sodium.

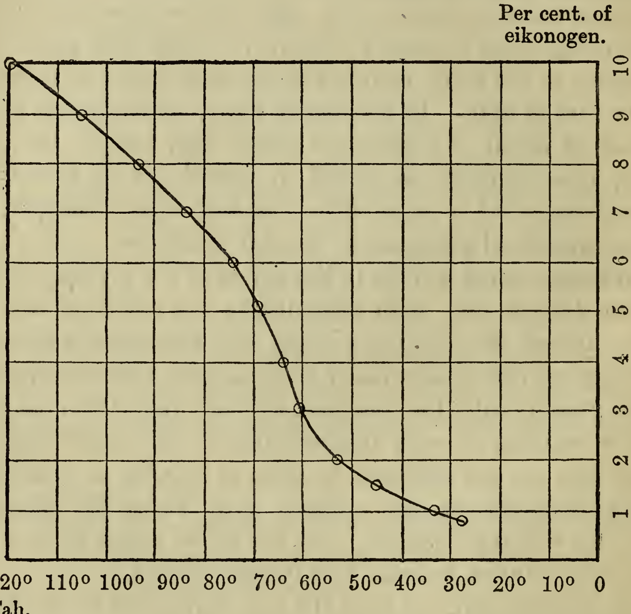
Eikonogen is not soluble to the extent of ten per cent., but is soluble, though only with difficulty, to the extent of five per cent. Indeed, the principal trouble with eikonogen is that it is sparingly soluble at all ordinary temperatures, that the solubility varies greatly with the temperature, and that the quantities held in solution at such temperatures as 40° to 50° Fah., or below 40°, are not sufficient to allow of mixing a sufficiently strong developer, in the ordinary way, where the alkali is kept in a different solution, and has to be added so that the eikonogen solution becomes still further diluted.

The diagram given on page 106 was worked out by the writer to show the variation in the solubility of eikonogen at different temperatures, and first appeared in *Photography*.

In this the ordinates, or vertical lines, represent quantity of eikonogen dissolved, the abscissæ or horizontal lines represent temperature in degrees Fah. If it is wished to find the quantity of eikonogen soluble at any particular temperature, all that has to be done is to look up that temperature at the bottom of the diagram, run the eye up the vertical line from it till the curve is reached, then run the eye along the horizontal line to the

right, when the percentage soluble at that particular temperature is found.

Thus it will be seen that, at 40°, only about $1\frac{1}{4}$ per cent. is soluble, at 50° only about $1\frac{3}{4}$ per cent., at 60° somewhat less than 3 per cent., and that it needs a temperature of nearly 70°



to dissolve 5 per cent., whilst 10 per cent., needing a temperature of 120°, is practically out of the question. These solubilities are in a 10 per cent. solution of sulphite of soda, but probably differ very little from solubilities in water.

In spite of the varying solubility of eikonogen, the writer has found the use of a saturated solution, in a ten per cent. solution of sulphite of soda, as a stock solution, very convenient. Into a bottle of considerable size there is put much more eikonogen than can be dissolved. The bottle is filled up with a ten per

cent. solution of sulphite of soda, is thoroughly shaken, and the resulting solution forms the stock solution. The bottle is simply filled up with a ten per cent. solution of sulphite of soda at the end of the day's work. An idea of the strength of the solution can always be got by referring to the cut given on page 106, if the temperature be known. I have now kept the same eikonogen solution going for more than two years. It is in a quart bottle, and a half kilo of fresh eikonogen has been added from time to time.

The work that I have done with eikonogen leads me to conclude that to equal pyro in effect it is necessary to use three times as much, and that, also, if large quantities of carbonate be used with it, a little bromide of potassium should be added even for normal exposure. The following developer has been found to give very satisfactory results:—

Five per cent. solution of eikonogen (or a correspondingly greater or less quantity of a weaker or stronger solution)...	120 minims
Ten per cent. solution of carbonate of soda (washing soda)	100 ,,

To each ounce of developer needed.*

The mixed developer will be found to be of a delicate green tint. It may be used for the development of several plates in succession.

The eikonogen developer tends to give very soft images, and is therefore useful in cases where hardness or chalkiness has to be guarded against.

A mixed developer of pyro and eikonogen has certain

* Five per cent. solution of eikonogen	8 c.c.
Ten per cent. solution of carbonate of soda	6 c.c.
Water to make the solution up to	30 c.c.

advantages. Indeed, it seems to show the good qualities of both the substances. If the normal pyro developer given in the last chapter be mixed up, substituting for a portion of the water 50 minims of a 5 per cent. solution of eikonogen, or a correspondingly greater or less quantity of a weaker or stronger solution, a developer results that is somewhat quicker in its action than pyro alone, gives a somewhat softer image, though not so soft as that generally got with eikonogen only, and that has much less tendency to stain the hands, the finger nails, &c.

There is another use for eikonogen that may be explained as follows :—It will sometimes be found, in developing with pyro, that whatever care has been taken, it is evident the image is going to be hard. The lights are getting too dense before the shadow detail comes up. The assumption is that the exposure is such that the detail *will* come up in time. If, in such a case, the plate be taken from the bath, be held in the hand, and there be flowed over it an eikonogen developer mixed as advised above, but with twice the quantity of alkali, the detail will quickly come up, without any apparent increase in the density of the high-lights. Eikonogen must on no account be used with the ammonia developer.

The Para-Amidophenol Developer.— This is another new developer that has had much popularity lately. Like eikonogen, it is a coal tar product. It is energetic in its action, and gives soft images of excellent colour. It is but slightly soluble in water, but dissolves readily in certain alkaline solutions. The writer has not had an opportunity of trying it in its pure state, but has worked with rodinal, which he believes to contain para-amidophenol, and either caustic soda or caustic potash.

The developer, even diluted thirty times with water, according to instructions, was found to be extraordinarily rapid in its action, and to give soft harmonious images. No addition but water is needed, and the solution, undiluted, keeps remarkably

well, even after the bottle has been opened. After dilution it keeps well enough to allow of the development of several plates one after the other.

This developer would seem particularly suited to studio work, in which the exposure is pretty certain, soft negatives are a desideratum, and it is useful to have development finished as quickly as possible.

The Ferrous Oxalate Developer.—All the developers that have been as yet described have one character in common: they are all "alkaline" developers—that is to say, the solution has to be made distinctly alkaline to bring out its energy as a developer. It is true that eikonogen will work without the addition of an alkali, but the developer now to be described is totally different from any of the others, inasmuch as the first condition for successful working is that the solution be not alkaline. The ferrous oxalate developer was a great favourite when gelatino-bromide dry plates were first introduced, and there are still a few in England who use it—many in Germany. It has the advantage over pyro at least of cleanliness and simplicity, and gives an image of a very fine black; but most photographers consider that it does not give the operator so complete a control over his results in the case of variety of subject or error in exposure. Still, there are some who say that they have quite as much control with oxalate as with pyro.

The common way of mixing the developer is as follows:—A saturated solution of oxalate of potash is made. The oxalate of potash in the market is generally somewhat alkaline, and, as has been said, alkalinity is not permissible in the case of the oxalate developer. It is, therefore, necessary to neutralise this solution, or, still better, to render it distinctly acid. This may be done by preparing a strong solution of citric acid, and by adding this to the oxalate solution a little at a time, till blue litmus paper is turned red. No harm will be done if enough

acid be added to turn the colour of blue litmus paper quite quickly.

The other solution needed is a saturated solution* of ferrous sulphate, commonly known among photographers as proto-sulphate of iron. This salt is never alkaline.

A normal developer is made by mixing *about* three parts of the saturated solution of oxalate of potash with one of the ferrous sulphate solution. The latter should be poured into the former, not *vice versa*. A beautiful red liquid results; that is the developer, to be used in precisely the same way as any of those already described. I have said that the proportions should be *about* three to four. The larger the proportion of iron, the quicker the developer; but there is a limit beyond which, if the ferrous solution is added, a precipitate is formed. This limit is reached when one part of the iron salt is used with about two of the oxalate. If, on the other hand, a smaller proportion of the iron salt is used, the development is slower; but, unless the quantity be very much reduced, as much, or nearly as much, detail will eventually be got out as with the more concentrated developer. Thus, many work with proportions

* When saturated solutions are made in any large quantities, the best way of making them is to take an open jar sufficiently large to hold all the solution, to place in a muslin bag a little more of the salt than will dissolve in the water, and to suspend this a few inches below the upper edge of the jar by a piece of string tied to a stick or a glass rod laid across the top of the jar. The jar is then filled with water, and is set on one side for twenty-four hours or so. When only small quantities are to be made, it will probably be found most convenient to fill a bottle about half full with warm water, and to add the salt with constant shaking till no more will dissolve. In this case there will probably be some deposit at the bottom of the bottle on cooling, but that is of no consequence. At the end of the book is given, among other Tables, a table of the solubility of photographic chemicals, which will be found useful.

of about six to one, and some prefer even to dilute such a solution with an equal part of water.

Bromide of ammonium, or of potassium, may be used to compensate for over-exposure just as with the alkaline developer.

Several plates in succession may be developed in the same solution if no long time is allowed to elapse, but the solution gradually absorbs oxygen from the air, and becomes exhausted.

The ferrous oxalate developer lends itself particularly well to the systematic development of a number of plates in succession, and is therefore used in many large professional establishments on the Continent. One of the best ways of going to work is as follows:—Three vertical baths are used. These are baths into which the plate can be lowered vertically by the aid of a "dipper." They expose to the air only a comparatively small surface of the liquid, which, consequently, does not deteriorate so rapidly as in flat baths, and, being of glass, it is possible to watch the progress of development by placing a lamp at the back, and looking through both bath and plate.

No. 1 bath may be filled with solution made of 5 parts oxalate solution to 2 parts iron; No. 2 with 5 parts oxalate solution to 1 part iron; No. 3 with the same as No. 2, but having one grain of bromide of ammonium added to each ounce.

The plates, as they come for development, go first into No. 2, and, if all is going well with them, remain there till the development is complete. If they appear to want hurrying up, they are transferred to No. 1; if they appear to be over-exposed, and to want retarding, they go to No. 3.

When an oxalate developer has been used for some time, the effect is the same as if it were much retarded with bromide. In the case of the three baths mentioned, therefore, it is not necessary to throw away all when they begin to work too slowly.

No. 3 only is thrown away; No. 2 takes its place; No. 1 takes the place of No. 2; and a fresh No. 1 is made up.

A very concentrated oxalate developer may be made in the following manner:—A bottle is half filled with a saturated solution of oxalate of potash, and powdered ferrous sulphate is added, with much shaking, till no more will be taken up, or till there appears to be a deposit. An ounce of solution should take up about 80 to 100 grains of ferrous sulphate. Should there be a *thick*, orange-coloured, flocculent deposit, it shows that too much iron salt has been added, and enough oxalate of potash solution should be added to re-dissolve it. This concentrated solution is exceedingly energetic in its action—so energetic, in fact, as to make development almost beyond control, and to fog some kinds of plates even when they have not been acted on by light. It may, however, be used as an additional bath to the three mentioned, to be used when it is wished to get the very most possible out of an under-exposed plate.

The addition of a trace of hyposulphite of soda to the oxalate developer hastens development greatly, and, perhaps, brings out a little extra detail. Of a one per cent. solution of hyposulphite of soda, any quantity up to about 40 or 50 minims to the ounce of developer may be added, or the plate may be removed from the developing dish, and flowed for a few seconds with a solution of one part of hyposulphite of soda in 1,000 of water; then returned to the developer.

In using the oxalate developer, it should be borne in mind that soluble salts of iron form common ink with pyrogallic acid, and that, therefore, all dishes, &c., that have been used for the one must be most carefully washed before they are used for the other.

Other Developers.—There are many substances besides those described that have some developing action—in fact, almost

every powerful absorber of oxygen that is soluble in water is more or less of a developer—and many of them are useful for special purposes; but I think it may be taken that those I have described are the only ones that are of general use in ordinary negative work. My own opinion at the time of writing is that, taking everything into consideration, pyro is still the best all-round developer that we have.

[Since this chapter was written, several new developers, having such names as "amidol," "metol," &c., have been placed on the market. Certain advantages are claimed for each of them. Thus it is held by some that they permit of shortening the exposure to a certain extent. It is certain that they work very cleanly, and give negatives of a beautiful colour. I do not consider it necessary here to describe these developers in full, as I still consider that our old friend "pyro" holds its own, as instructions are issued with the developers mentioned, and as anyone who can work with pyrogallic acid can have no difficulty in working with the new developers. I certainly recommend the beginner not to dabble with these new developers till he has thoroughly mastered "pyro."]

CHAPTER XIII.

DEFECTS AND REMEDIES.

The photographer will certainly not practise the gelatine dry-plate process very long before he comes across some of the defects that are peculiar to it. I intend, therefore, to describe these as accurately as I can, and, where possible, to give a means of either preventing the occurrence of the objectionable phenomenon, or of curing it when it has made its appearance. When the error is of a kind due to the *preparation* of the plates, I shall not enter into the cause of it, but merely, where possible, indicate the cure.

General fog.—This is probably the commonest of all faults in gelatine negatives. It consists of a veil over the whole plate, showing itself by want of transparency in the shadows. It may be so slight as to be imperceptible, except when the negative is laid face downwards on a sheet of white paper, and, in fact, almost always exists to this extent in gelatine negatives; or may be so dense as to make the time necessary to get a print be measured by days. It is due to one of two causes, which are usually indicated by the terms *chemical fog* and *light fog*.

The first arises from error in the preparation of the plate. By it is meant that the sensitive film is in such a condition

that the silver salt is reduced by the developer without light having acted upon it.

The best way to distinguish chemical fog from light fog is to develop an unexposed plate, performing all the operations in total darkness. This is not difficult. If the plate is found to have darkened, the fog is chemical fog, or, what is practically the same thing to the photographer, light fog brought about by the action of light on the emulsion whilst in the hands of the manufacturer.

With well-restrained developers, chemical fog is less likely to make its appearance than with strong developers. Indeed, if plates show only a slight tendency to show chemical fog, the tendency may be entirely overcome by somewhat increasing the exposure, say by 50 per cent., and by adding enough bromide of potassium or of ammonium to the developer to counteract this slight over-exposure.

Light fog is due to the action of light in one of three ways: first, on account of an unsafe light in the dark-room; secondly, on account of a defect in the camera or dark slide admitting light; and thirdly, on account of over-exposure.

When the fog is due to light in the camera, this will be recognized by the fact that the portions of the plates covered by the wires or rebates of the dark slides remain free from fog. When this is the case, the camera must be carefully examined by removing the focussing screen, and looking for the smallest defect which might admit light, the camera being placed in direct sunshine, and the head of the observer being covered with the focussing cloth. Light finding its way through defects in the slides generally shows itself in the form of streaks or lines. Should no defect be detected, it may be assumed that over-exposure is the cause of the fog, and a shorter may be tried.

If fog from unsafe light in the dark-room be suspected, a

plate is placed in the dark slide, one of the shutters is drawn half-way, and the slide is laid for five minutes on the table where the plates are changed and developed. The plate is then developed, and if one-half darkens, it shows that the light is not safe, and steps must be taken to render it so.

Green fog.—This defect is always due to error in the manufacture of the plates. It generally makes its appearance only in the shadows of the negative. If the negative be looked at by reflected light, a black object being laid under it, the shadows will be seen to be bright green. On looking through the negative they may appear somewhat pink, or sometimes a sort of "muddy" colour.

A slight amount of green fog is not detrimental to the printing qualities of a negative; but if the defect show itself in an aggravated form, the best means of preventing it is to avoid the use of either pyro or eikonogen in conjunction with ammonia. Captain Abney has recently given a means of curing plates afflicted with green fog after development. It consists in bleaching the negative with a solution of ferric bromide, oxalate, or chloride, and afterwards applying the ferrous-oxalate developer.

Red fog seems to be an aggravated form of the last-mentioned disease. It appears as a deep red deposit, showing itself by transmitted light in the shadows of the negative. It is rarely met with at the present time, although it was common in the early days of gelatine plates. Probably Captain Abney's cure for green fog would correct this defect also.*

Leaving out of the question eikonogen and ammonia, which

* It would be better to class the above two kinds of fog as "colour fog." The two colours mentioned are certainly the commonest, but I think I have seen, especially when experimenting with eikonogen, every colour of the rainbow well represented. Abney's method can barely be said to be a *cure* for colour fog. It is simply a means of converting it to *grey* fog (chemical fog), in which form it is generally comparatively harmless.

should *never* be used together, these colour-fogs seldom show themselves except with pyro and ammonia, and then, as a rule, only when exposure has been too short, and "forcing" has been resorted to in development. They may show in a very aggravated form if alkaline or otherwise impure oxalate of potash be used for the ferrous-oxalate developer.

Frilling consists in an expansion of the film to such an extent that it loses its adhesion to the glass, and "frills" off. The phenomenon begins at the edge of the plate, and spreads towards the centre. When the expansion begins at the centre it is termed blistering. It is due to an error in the manufacture of the plate, but is much aggravated by a developer strong in alkali, by the use of warm solutions, by the use of too strong a fixing bath, or by the use of very soft water for washing. When it makes its appearance only in the fixing bath or during washing, it may be prevented almost with certainty by placing the plate, immediately after development, in a saturated solution of alum for five minutes. This I advise in all cases; but where there is no fear of frilling, the plate should be thoroughly rinsed before it is placed in the alum solution.

In an extreme case, where ordinary alum is found not to be effectual, chrome alum, which is more energetic in its action, may be used; but care must be taken to see that the solution does not contain free acid.

If the frilling be of so aggravated a form as to show itself during development, it is more difficult to prevent its occurrence. The best preventive that I know is that suggested by Mr. W. B. Bolton, namely, to use a saturated solution of common salt, instead of plain water, in making up the developer. If the oxalate developer be used, the plates may be placed in an alum bath *before* development. This is a certain cure, but is not permissible in the case of alkaline development.

Plates that frill when newly prepared, in many cases, after

keeping for some weeks or months in a dry place, show no tendency to the defect. In fact, I have found that the keeping of gelatine plates for some time often improves them in many ways.

Want of density or flatness of image is usually due to under-development, or to the use of too weak a developer, and very often to over-exposure combined with one of these. A consideration of the remarks in the last chapter on development will show how sufficient density may be gained in almost any case; and I may here say that, when the ammonia developer is used, a very common cause of want of vigour is to be found in the fact that the ammonia is not so strong as is supposed, and that the development is not protracted for the time which would be necessary to get density with a developer weak in ammonia. A very short exposure to the air weakens liquid ammonia of ·880 specific gravity, because ammonia gas escapes. It will be generally found that the last of the ammonia in a bottle is considerably below the standard strength, simply from the escape of the gas every time the bottle is opened. It is for this reason that the dilution of the ammonia with an equal bulk of water, immediately after purchasing it, was recommended. Merely pouring the strongest ammonia from one bottle to another will perceptibly weaken it.

A reference to what has been written about the comparatively slight solubility of eikonogen at low temperature will explain why it is that it is sometimes impossible to get sufficient density with this developer in cold weather.

There are some plates that will not give a vigorous negative, however they be developed. This is the case with plates on which the emulsion has been too thinly spread. If such plates are to be used at all, an after process of intensification must be resorted to. It will occasionally happen, too, with the best of plates, that an error of judgment is made in development,

and that the process is stopped before density is sufficient. This is another case for intensification. I shall treat of intensification in a separate chapter.

Too great density of image is a fault sometimes met with. It is always due to error of judgment in development. If the high lights alone are too dense, the shadow details being thin, there is no cure; but if there be general over-density of both shadow and detail, a cure can be found in "reduction of density," which will be described in the next chapter.

Spots of various kinds are liable to be found in the finished negative. They are of various forms, and are produced in various ways.

Minute transparent spots or pinholes are caused by dust resting on the plate during exposure. The plate should be brushed with a broad camel's hair brush, or a tuft of fine cotton wool, before it is placed in the slide.

Small transparent spots with irregular outlines are due to defect in the manufacture of the plate, and cannot be corrected by after manipulation other than that of the retoucher's pencil.

Small, transparent, perfectly circular spots, with well-defined outlines, are due to air-bubbles in the developer, and are generally produced when too small a quantity of developer is used.

Opaque spots are almost always due to defects in the plates, and cannot be corrected by after-manipulation. They may occasionally arise from foreign matter in the developer.

A yellow stain over the whole of a negative is often found after pyrogallic development, especially if ammonia has been used. Plates vary greatly in their liability to this defect. With most it will not occur if the instructions with regard to the use of the alum bath after development be carefully

followed; but, if it do, it may be removed by placing the negative, after fixing and washing, in the following:—

Saturated solution of alum	10 ounces
Hydrochloric acid	½ ounce*

This defect has become much less common since the general introduction of the use of sulphite of soda in the alkaline developer.

A yellow fog occasionally occurs, and must not be confused with the stain described. It is, in fact, a variety of the colour fogs of which the green and red are the commonest, and is to be treated as such. It is to be distinguished from the stain by the fact that it is yellow only by reflected light, whilst the stain is yellow only by transmitted light.

Unequal thickness of film is sometimes found in commercial plates.† It arises from careless coating of the glass, and is, of course, incurable by after-treatment. The negative resulting from a plate more thinly coated at one place than at another may be lacking in density at the thin place; but it should be borne in mind that it need not certainly be so. Plates are generally coated with films considerably thicker than is absolutely necessary, and, in the case of a plate unequally coated, the thinnest part may contain enough of the silver salt to give the necessary density. Plates should, therefore, be tried before being condemned for unequal coating.

Various *streaks*, *scratches*, *&c.*, occur in gelatine plates, and are evidently due to defects in manufacture, or more often to careless treatment by the photographer afterwards. They call for no particular remark.

A white, powdery deposit is sometimes found on the surface of

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* Hydrochloric acid...	50 c.c.
Saturated solution of alum	1 litre

† Very rarely at the present time.

the negative after drying, especially in the case of ferrous-oxalate development. It is in such a case caused by lime in the washing water. It may be removed by dipping the negative in a 1 per cent. solution of hydrochloric acid. If the solution of alum used before fixing be acid, and the negative be not sufficiently washed between the alum and the fixing bath, a deposit of sulphur may form on the film in a fine powder. This can be removed by gently rubbing the face of a negative with a plug of cotton-wool while water is running on it from the tap.

Irregular action of the developer, causing zig-zag lines across the plate, may occur if the developer has not been made to flow over the plate in one wave at first.

Halation is caused chiefly by reflection of light from the back of the plate. It makes itself evident only when the subject includes very strong contrasts; for example, when an interior with windows open to the sky is photographed, it shows itself in the form of a halo round the highest lights, and produces a very unpleasant effect, sometimes known as blurring. It occurs only to a small extent with plates that are very thickly coated.

In the case of an attempt being made to photograph a very trying subject, such as the interior mentioned, it is well to back the plate; that is, to paint or otherwise cover it at the back with some substance which will absorb light.

The best substance for backing plates is a solution of caramel, or burnt sugar, introduced by Mr. W. E. Debenham some little time ago. If there is any difficulty in purchasing caramel, it can be readily made by heating white sugar at a temperature of about 400° Fah., till it is converted into a black porous mass. This is dissolved in enough water to make a solution that can be readily spread on the back of a plate with a brush. The plate, after the back is coated, is placed on one side to dry, and before development the caramel is washed from the back with water.

It is to be observed that halation scarcely makes its appearance at all where sensitive paper is used in place of glass (see Chapter XV).

Solarisation, or reversal of the image, is a curious phonomenon which may be brought about in any gelatine plate. It consists in a reversed action of light—or, rather, a reversed action of the developer, produced by excessive action of light. It is found that if light, beyond a certain amount, be allowed to act on a sensitive film, *less* instead of greater density occurs after development by the increase. This peculiar action does not, as a rule, give rise to practical inconvenience; but if, for example, the sun be included in a photograph, it will usually be found to be represented by a *transparent* spot on the negative, and consequently by a black spot in the print. Tendency to reversal is much greater in some plates than in others.

CHAPTER XIV.

INTENSIFICATION AND REDUCTION OF THE NEGATIVE.—VARNISHING.

At the end of the last chapter I described the conditions that give rise to the occasional necessity for intensifying or reducing a negative. The term intensification almost explains itself. It means the increasing of the density of a negative. A good intensifier will increase the density of every part of a negative proportionately; that is to say, when there is, after fixing, clear glass in the shadows, no darkening will take place there; but every grade of density, from the finest detail to the densest high-light, will be increased in a proportionate degree. The process ought to be thoroughly at the command of the operator, who should be able to produce any desired increase of density.

I may say at once that in my opinion there is no thoroughly satisfactory intensifier for gelatine negatives, and that such a thing is a great desideratum. It does not fall within the province of this little work to enter into a discussion as to which is the best of the various more or less imperfect methods that have from time to time been published; but I shall give a formula which has, at any rate, the advantage of simplicity, and which will be found to give fairly good results. It is one of the "mercury" intensifiers. It has two drawbacks: first,

the results are not always permanent*; second, there is great difficulty in regulating the amount of intensification given by it.

Let us suppose that a negative, on printing, is found to give a poor-looking print, lacking contrast. The following solution is prepared:—

Bichloride of mercury	1 ounce
Water	10 ounces

The whole of the bichloride of mercury will not dissolve, but the residue may be left in the bottle, and as the solution gets low through unavoidable waste, water may be added.

The negative is very thoroughly washed. It is placed in a dish, and the mercury solution is poured over it. It will gradually become whitened or bleached. When the film is bleached throughout—as indicated by its being white at the back—the solution is poured back into the bottle, and the negative is again most thoroughly washed. On the thoroughness of this washing seems to depend to a great degree the permanency of the results.

The negative has now to be treated with ammonia solution, which will blacken it; but the strength of the ammonia solution must be varied according to the amount of density needed. Thus, if the print got from the negative previous to treating with mercury was nearly up to the mark, a very weak solution of ammonia must be used: one or two drops to the ounce of water will be enough. This solution is poured over the negative, which will be seen gradually to darken. When all action ceases, the process is complete. The negative will now be of a

* I think the want of permanency of mercury intensified negatives has been greatly exaggerated. Living in a climate that is terribly severe on gelatine negatives, I have lost a much larger percentage of unintensified than of intensified negatives. The commonest cause of loss has been discolouration due to insufficient fixing.

brownish tinge by transmitted light. If, on the other hand, the negative was one giving a very shadowy print, a mixture of ammonia and water in the proportion of one to twenty may be used. On this being poured over the plate, darkening will take place almost instantly, and the result will be a fine, black-coloured negative.

If it appear necessary, the operation of intensification may be repeated several times, the result being an increase, but a lesser increase, of density each time the operation is performed. In the case of repeated intensification, the washing after each stage of the process must be very thorough, or there is nearly sure to be staining of the film.

An intensifier of more recent introduction than the ammonia intensifier is the sulphite. This intensifier is very useful when only a little increase of density is needed. Indeed, most will prefer it to working with very weak ammonia as indicated above. In this intensifier sulphite of soda replaces the ammonia, with the result, it is said, of a more permanent print. This is, of course, an advantage; and another is, that a far less thorough washing after bleaching suffices—indeed, a good rinse is all that is actually necessary. The precise strength of the sulphite solution is not of great consequence: a ten per cent. solution may be used. As indicated above, it is not possible to intensify to nearly so great an extent with the sulphite as with ammonia, for which reason, when the negative is *very* weak, the latter should be used.

Should the intensification turn out to be too great, the plate, after washing, may be placed in the hypo bath. This will remove a portion of the intensity given by intensification, whether ammonia or sulphite has been used.

Reduction of Negatives.—This process has already been mentioned. It is the exact reverse of intensification. A word or two has also been said of the cases in which it is available, and of those in which it is not.

By far the best reducer, in the writer's opinion, is Howard Farmer's ferricyanide of potassium reducer. The method of operating it is as follows. Let me say, however, in the first place, that if the need for reduction is evident after fixing and washing, the operation should take place at once, the negative not being allowed to dry. The process is much quicker, is more under control, and is less liable to be unequal in its action than if the negative has dried and has to be wetted again. Very often there is some doubt as to whether reduction is necessary or not. In such cases it is, of course, requisite to dry the plate, and afterwards to wet it again.

A fresh solution of hyposulphite of soda, which may be of the strength of the ordinary fixing bath, is made up, as is also a saturated solution of ferricyanide of potassium, or, as it is commonly called, red prussiate of potash. If the plate has been allowed to dry, it should be steeped in the hypo solution for some time till the film's repellance of the liquid is overcome. If it has not been dried, the operation may proceed at once.

A few drops of the red prussiate of potash are poured into a measuring glass, the hypo solution is poured over it so that there is thorough mixture, and then this mixture is flowed over the plate. A slight reduction of density will probably very soon be evident. Should the action cease whilst the reduction is still insufficient, more red prussiate of potash solution is added. Care should be taken not to allow the action to go too far.

Varnishing Negatives.—The object of varnishing negatives is to protect the gelatine film from the action of the atmosphere, from mechanical injury, and when printing paper is sensitised at home, and is liable to be used before it is quite dry, particularly to protect the film from staining by nitrate of silver. It is possible, as will be explained hereafter, to remove a nitrate of silver stain from a film of varnish ; it is not, so far as the writer

knows, possible to remove it from the gelatine film—at any rate, without endangering the image.

It is advisable to take a trial print from every negative before the process of varnishing is performed; and, in fact, if ready-sensitised paper, which is always quite dry, be used, varnishing is not absolutely necessary at all; it is very advisable, however. After the negative is thoroughly washed and quite dry, it is taken by that corner which, were it a printed page, would be called the left-hand bottom corner. It is warmed gently over a gas-burner till it is just warm enough to feel pleasant to the touch. If a gas-burner fixed above the level of the operator's head be used, a good criterion of the proper temperature is gained by watching the moisture which condenses on the plate from the water formed by the combustion of the gas. When the moisture at first condensed is dispersed, and no more will condense on a plate, it is just at the right temperature. The plate is now held level, by the corner mentioned, between the finger and thumb of the left hand, whilst the varnish bottle is held in the right hand. A large pool of varnish is gently poured on to the centre of the plate. This pool should cover about half of the area of the glass. The plate is gently "tipped," so as to cause the varnish to flow first to one corner and then to another, beginning at that opposite to the one by which it is held. When the varnish comes round to the bottom right-hand corner, the plate is tipped slowly up to a vertical position, so that all the excess of varnish may flow back into the bottle. The plate must be rocked from side to side during this part of the process, to prevent the formation of crapey lines. When all the excess of varnish has flowed off, the plate must be again warmed—this time till it is about as hot as the hand can bear. When it is cold, it is ready to be printed from. There is a vast difference between plates as to the ease with which the varnish will flow over them. The

process is one that should in no case be performed over a choice carpet.

Removing Varnish from Negatives.—It is sometimes necessary to remove the varnish from a negative. It may, for example, appear that, after all, the negative ought to be intensified, or reduced. The commonest cause for the necessity for varnishing, however, arises from staining by contact with silver sensitised paper that is not perfectly dry. If such staining is noticed, the varnish should be removed at once. If this be done, the stain will come away with it. If a length of time be allowed to elapse, the stain will probably penetrate to the gelatine, and then removal will be impossible.

The best way in which to remove varnish is as follows:—A porcelain dish is used. Some methylated spirit is heated to something approaching the boiling point. The dish and the negative are both warmed. The spirit is then poured over the negative in the dish, and immediately the film is lightly rubbed with a pad of cotton wool. A final rinse is given with clean spirit, when it will be found that the varnish is entirely gone.

CHAPTER XV.

NEGATIVES ON PAPER AND OTHER FLEXIBLE SUPPORTS.

In the first negative process that was invented—that entitled the Talbotype, from its originator, Fox Talbot—the sensitive film was supported on paper. It was not till Archer invented the collodion process in 1850 that glass was generally used as a support for the film. The great advantage that the collodion process offered over any that had gone before caused it to be adopted in spite of the one drawback—the weight and breakability of the glass. From that time to this, however, it may be said that the glass has been used only under protest. It has always been felt that at some time paper, or some such light and flexible substance, would take its place, and that this should be used in continuous rolls. Even the introduction of a means of using paper in continuous lengths is by no means a new thing. If I am not mistaken, a roller slide for exposing sensitive paper—such as was used in the Talbotype process—is a thing of twenty-five or thirty years old. Coming up to recent times, however, Mr. L. Warnerke has been the pioneer in this matter of paper coated with emulsion. He brought out a roller slide for the use of collodio-bromide films a good many years ago; he afterwards gave his attention to the preparation of paper coated with gelatine emulsion, and other manufacturers followed his example.

The advantage of paper or films over glass may be summed up in a few words.

The two first mentioned are enormously lighter, both as regards carriage in bulk, and in the slide or slides; and the finished negatives are both lighter and easier to store. They are not liable to breakage.

By the arrangement known as the roller slide, to be hereafter described, it is possible to make exposures, one after another, at a rate quite impossible with glass plates.

Halation does not make its appearance with paper or films to nearly the same extent as with glass.

The negatives can be printed from either side. This is a great advantage in many cases. The advantage in the case of cloud negatives will readily be understood by those who have practised the printing-in of clouds; the advantage in the case of the carbon process will be understood by all those who know the difference between single and double transfers; whilst those who are acquainted with photo-mechanical work will readily appreciate the advantage of being able to print from the back of negatives without appreciable loss of definition.

The operation of retouching is greatly facilitated in the case of paper. This can readily be conceived, especially when it is borne in mind that both sides of the paper are amenable to treatment with the pencil.

The process of development is more expeditious when a number of exposures have been made than where glass is used. It is, in fact, quite possible to develop a dozen films at the same time.

On the other hand, additional apparatus is needed for holding the paper or films in position. The drying of the paper, and of at least some films, is somewhat troublesome. On the whole, the advantages seem to more than compensate for the drawbacks, at all events for out of doors work.

It is undoubtedly the case that the tendency towards the adoption of some flexible support in place of glass for sensitive films is due to the enterprise of the Eastman Dry Plate and Film Company, who put on the market a roller slide—or roll-holder, as they call it—of marvellous ingenuity, besides all the requisites for working the process.

The roll-holder consists of an appliance which slides into the groove of the camera made for the ordinary dark-slide. When

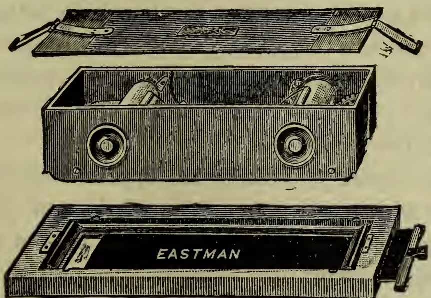


Fig. 1.

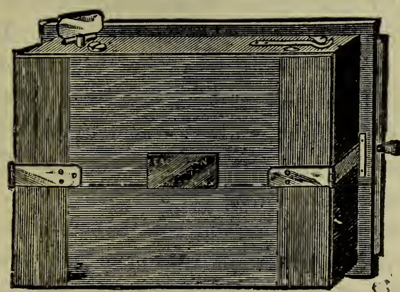


Fig. 2.

the roll-holder is placed in position, a portion of a continuous roll of sensitive film is brought into the plane occupied by the ground glass while the image was being focussed. Between this film and the lens there intervenes nothing but a shutter

similar to that used with an ordinary dark-slide. In fact, the film on its basis simply replaces the film on glass, but with this very great difference, that when it is necessary to replace one film with another, instead of having to reverse the slide or take up another one, we have only to turn a key till a certain indication is given, when, by the winding of the exposed film on to one roller, we have a fresh film in position. This process can be repeated till all the films are exposed. The film is afterwards unwound from the spool (which latter is removable), is cut up into lengths by marks which guiding rollers produce in revolving, and is developed. A second roll may then be placed in the slide. The film is sent out ready wound on spools to fit the apparatus.

I cannot give space to describe the appliance in detail, but I give two cuts which will give a very fair idea of it. The first shows it open for the removal or reception of a spool. The second shows it ready for use.

Celluloid films have so completely superseded paper, that the somewhat lengthy description of the manipulation of the latter that was given in former editions is omitted here. The first paper that was used to any extent was the "biding paper" of the Eastman-Walker firm. This paper was exposed and developed in the usual way, and, when dry, was treated with an oily or greasy substance that rendered it translucent, and did away with the grains of the paper entirely, or at least nearly. In the case of some kinds of work, excellent results could be got with this paper, but where the gradation was very fine, the grain of the paper spoiled the effect in spite of the "biding."

Next there came "strippers." The stripping film consisted of paper coated first with a film of soluble gelatine, and afterwards with a film of emulsion rendered insoluble with chrome alum. These films were developed like the "biders," but afterwards they were squeegeed down to plates of waxed glass, and

were treated with hot water. The soluble substratum of gelatine melted, and allowed the paper to be "stripped" off, leaving the image on the glass. A "skin," or thickish sheet of gelatine, was then applied, the whole was set on one side, and, after drying had taken place, the "skin," now holding the image, could be "stripped" from the glass, when a perfect negative that could be printed from either side resulted.

Undoubtedly results equal to the best on glass were got by this process, but it was terribly troublesome to work, and moreover, sometimes, if the paper had been kept for a considerable time, the image would not leave it, the insolubility having penetrated to the substratum. I do not even know whether stripping films are now made at all or not. They have, at any rate, to all intents and purposes, been ousted by celluloid films.

Celluloid and other Films.

For years attempts were made, resulting in greater or less success, to produce flexible films that should be actually transparent. Gelatine rendered insoluble by the action of chromic acid, or combination of gelatine with collodion, were more or less successful; but these have all had to give way to celluloid films. Celluloid, being impervious to water, has distinct advantages over anything tried before. Films of this substance, coated with gelatine emulsion, were first introduced by Carbutt, of America. The film is actually as transparent as glass. They are not thicker than a sheet of stout paper, and are not in any way affected by aqueous solutions, so that they do not curl or stretch during development, &c., and are not troublesome in drying; the trouble in drying was the greatest difficulty with the films just mentioned above.

In my hands, celluloid films have given negatives in every way equal to those on glass, and having the advantage that there is no danger of halation from the back of a plate.

The films mentioned above are made in sheets the size of a plate only, but now films are being made in continuous rolls by the Eastman Company for their roll-holder.

These films are so thin that, in the case of some sizes of roll-holder, as much film as will serve for a hundred exposures can be held ready for exposure. One result of this extreme thinness is, that there is a little trouble in drying, the films tending to roll up into thin spills that are somewhat unmanageable. A little care and due attention to the instructions issued with the films will soon result in the overcoming of all difficulty. I do not consider it necessary to give detailed instructions, as these are sent out with the films and the roll-holders, but merely give the following general directions:—

Films to be developed are dipped in clean water for a few minutes till all inclination to curl ceases. After that, they are placed in a dish, and are developed precisely as glass plates are. Of course, as in the case of glass plates, the formula for development given by the maker of the paper should be used.

Several films may be developed in the same dish if this be somewhat larger in size than the paper. The lowest film is continually lifted and placed on the top.

If there be a number of films to develop, and there be doubt as to the correctness of the exposure, it is well to use two separate dishes of developer, No. 1 filled with a very much restrained developer, No. 2 with a normal solution. The films are all placed into No. 1, after soaking in water. Those which show an image in this bath before very long, proving that they have been over-exposed, are allowed to remain in it till they are finished; whilst those that do not show for several minutes, or only show the highest lights then, are transferred to No. 2. If here they come up too rapidly, and show a tendency to veil over in the shadows before density in the lights is sufficient, they may still be returned to No. 1. If they come up just as

they should, showing that exposure has been right, of course they need no farther development; whilst if they are under-exposed, as much can probably be got out of them by letting them remain for a long time in No. 2 as by any amount of forcing, by the addition of more alkali.

The use of the alum bath is recommended as with plates, and fixing is exactly the same.

CHAPTER XVI.

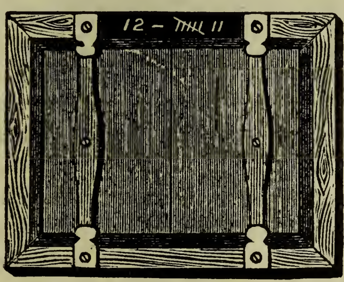
PRINTING AND TONING WITH READY-SENSITISED PAPER.

The photographer who has followed our instructions to the present point will so far have produced only means to an end; the end itself will be nowhere visible. He has made the materials for a picture, but the picture has still to be constructed from these materials. However delightful a negative may be to the photographer as containing infinite possibilities, it is to the common eye by no means a thing of beauty. Every shade is, as has been explained, reversed; before a natural effect can be produced, these shades must be re-reversed, so as to represent those of nature. This is commonly done by resorting to the process of printing. This process consists in placing in contact with the negative a sensitive film usually supported on paper, and allowing light to act on it through the negative—the effect being, as a little consideration will show, a reversal of all shades.

There are many printing processes, all of which may be studied with advantage by the amateur. Each one has certain advantages, and some are especially suited for certain purposes; but the process that, for a wonderfully long time, has held its own against all others, is "silver printing on albumenised paper." Times out of number it has been said that this process

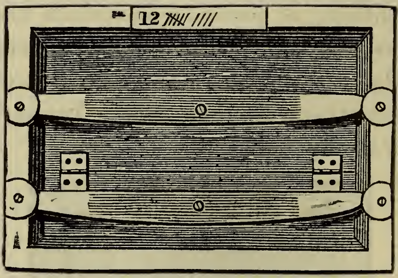
was doomed, yet it has survived. It seems, however, as if at last it were on the decline, being superseded not by one process only, but by a number of others, especially such as give a "matt" surface. Still, albumenised paper is, I think, likely to be largely used for some time to come at least. I therefore leave the chapters on the process as they were in the former editions, giving the principal of the processes that are now so generally worked in other chapters.

"Ready-sensitised" albumenised paper is an article of commerce, and its convenience is so great that its adoption is to be recommended to the beginner. I shall therefore here describe the manipulation of such paper before giving instructions in the sensitising of paper for immediate use. When the photographer has thoroughly mastered the process of printing, he will probably find that he can gain a higher degree of excellence by sensitising his own paper; but certainly at first the reverse will be the case.



In printing with albumenised paper a printing frame is used. This apparatus is of various forms, but all have the same object. They keep the paper in close contact with the negative, and are so constructed that one-half of the print can be examined at any time, whilst the other is kept in contact with the negative to prevent it from slipping. In frames made at the present day, the necessary pressure on the backs is gained

by the use of springs. For small negatives, the frame is usually made exactly to fit the plate. In the case of large negatives — above whole-plate, for example — the frame is generally made somewhat larger than the negative for which it is intended, and is fitted with plate-glass, against which the negative is placed. The pressure of the springs would be liable to break a large negative were it not thus protected. In the case of large negatives it is also necessary to use a pad of felt between the paper and the back of the frame, to ensure contact. Two of the commonest forms of printing frames are here illustrated. A neat "dodge" is shown at the side of the frame for registering the number of prints taken from any negative.



Let us suppose that our beginner has purchased a printing-frame and a certain amount of ready-sensitised paper. He cuts the paper to about the size of the negative he has determined to print from. He places a piece of the paper under the negative in the frame, and lays the whole outside in a bright diffused light. It is not generally advisable to print in direct sunlight. After the operation has gone on for a short time—say, five or ten minutes—the result may be ascertained by taking the frame into a weak light and examining the print, one-half at a time. It must be allowed to print considerably darker than it is finally to be. The exact amount of depth that is lost in the after-processes can only be learned by experi-

ence, but I may roughly say that it is necessary to print for nearly twice as long a time as that needed to give a pleasing result in the frame.

It is at this stage of proceedings that we for the first time become certain whether our negative is all that can be wished, or whether it may be improved by either reducing or increasing the density. It is necessary, to give a good result, in the case of most subjects, that the darkest part of the print should be about as dark as the paper is capable of becoming. It is also necessary that the negative should have such density that, while this takes place, the high-lights of the print may remain almost or quite white. If there be not such density, either one of two things must occur: either we must stop printing before the shadows are deep enough, and, as a consequence, there is no boldness of effect; or we must allow those parts that ought to remain white to get dark. The consequence is, in either case, lack of contrast. The cure is intensification of the negative.

On the other hand, we may find that we have too great density, and that, in consequence, not only the deepest shadows, but some of what ought to be only half tone, turn as dark as the paper is capable of becoming before the detail in the lighter parts becomes evident. It sometimes occurs in such a case, also, that the very dark parts assume a peculiar appearance known as "bronzing." In the case of an over-dense negative, one of two things occurs: we have large masses of shadow printed so dark that all detail is lost, or we have large masses of light in which detail has not made its appearance. The remedy, when remedy is possible, is reduction of density.

Sometimes, however, we find that we have a state of things not quite so bad as we have described, but that a negative shows indications of being a very little too dense or too thin. In this case it is a pity to resort to either intensification or reduction of density, as these processes are neither of

them very completely under control. We may proceed as follows:—

We clean thoroughly the back of the negative, and varnish it *cold*. After a time the varnish will set with a "matt" surface; that is, with a surface like ground glass. We now take it, and if the density be too great, we scrape away the varnish from the *densest parts*, using a penknife; if the density be too little, we scrape it away from the *transparent* parts. This will make a sensible difference in the resulting print; but if it still lack something, we may mark on the matt varnish with a soft pencil, in the case of too great density shading over the transparent portions, in the case of too little over the densest parts.

Another plan is to stretch a piece of tissue paper on the back of the negative, fixing it with glue at the edges only. This may then be worked on either with the stump or the pencil, the density being supplemented where needed. A negative dodged in either of these ways described may never be printed in direct sunshine.

It is to be noted that even without intensifying or dodging in any way, a slight amount of compensation for too great or too slight density may be gained simply by selecting a suitable light for printing in. Thus, if a negative be slightly too dense, a better result will be gained by printing in very bright sunlight than in the shade. If, on the other hand, it be slightly too thin, the best result is obtained by printing in a feeble light. The extent to which over and under density can in this manner be compensated for is but slight. I believe that the difference of result to be gained by printing in light more or less bright has been greatly exaggerated by most who have written on the subject.

When the desired number of proofs have been printed, the paper should be trimmed to the right size. This is generally

done, in the cases of small sizes, with scissors, using "cutting moulds," or thick plates of glass, that can be had of any size. It is often the custom to trim large prints, as well as small, by the aid of cutting moulds, but I think the plan is a mistake. It is very seldom that a print is not improved by cutting away a little foreground, a little sky, or a little of one side, and to be able to do this makes it impossible to keep to the precise size of any mould. Of course these remarks apply, strictly speaking, to small as well as to large prints, but the advantage of liberal trimming is far more conspicuous in the case of large than of small work. Moreover, two small sizes, the "carte" and the "cabinet," have got so firmly established, that if a print be anywhere near the size of one of them, it is considered well to trim it to the precise size.

In trimming large prints, I advise that the limits of the print be marked with pencil by the aid of a T-square and a drawing-board, the operator not hesitating to lop off considerable parts of his print if he think that a better picture will result thereby. The actual cutting may be done either with a sharp knife or a pair of scissors, or with one of the "wheel trimmers" first introduced from America some years ago.

One thing to observe in trimming prints is, that the edges must be made parallel to and perpendicular to any vertical line in the subject—for example, the corner of a building—or to the horizon, if it be a sea horizon.

Many prefer to trim their prints after they have gone through the various processes of toning, fixing, and washing; but there are several advantages in trimming before toning. The clippings, if kept, become, when a large quantity has accumulated, of value, on account of the silver in them; there is a saving of toning solutions, and the trimming is far easier before washing than after, as the paper lies flat, whereas afterwards it is liable to curl up in a way that makes it

difficult to manipulate. The following solution is mixed for toning:—

Chloride of gold*	15 grains
Acetate of soda	1 ounce
Water	up to 15 ounces

The chloride of gold is bought in small sealed tubes holding fifteen or thirty grains each. One of these tubes is placed in a bottle capable of holding the whole solution; when there, it is broken by striking it with a glass rod, due care being taken not to break the bottle, a thing that is quite possible. The acetate of soda is then added, and the water being poured in, the whole is shaken till the acetate dissolves. The solution must be kept at least twenty-four hours before use, and not be exposed to a strong light. It should be labelled "*Toning Solution, One Grain to the Ounce.*" The other solution which is needed is one of two ounces of hyposulphite of soda to each pint of water, with enough ammonia added to make the solution smell slightly of it, and should be labelled "*Fixing Solution for Prints.*"

It will be noticed that the prints, as they come from the frames, are generally of a more or less unpleasant colour. If they have a pleasing colour it is one that would disappear in the fixing bath were there no toning. The operation to be described, and which is called toning, is intended to correct this defect, and to give the prints the pleasing colour we are accustomed to see. The process consists in covering the image with an exceedingly thin film of gold, or rather, in substituting gold for a certain portion of the silver of the image.

* This is supposed to be the so-called "chloride of gold" of commerce, which is really a double chloride of gold and sodium. If actual terchloride of gold ($AuCl_3$) be used, the solution must be neutralised by shaking it up with powdered chalk, which is afterwards allowed to settle, before the acetate of soda is added.

Toning may be said to be at once the easiest and the most difficult of photographic processes. Nothing is easier than to *tone,* nothing more difficult than to tone *well.* Anyone can change the colour of a print to a sort of slatey grey; there are not very many who can be sure of getting at all times a pleasing tone and the exact tint wanted. The difficulty lies in the direction so common in photographic operation. A certain result is gained, but the after processes modify this result, so that great experience is necessary to know beforehand what will be the final appearance of the subject.

I shall describe as accurately as possible the operations, and for the rest, as in so many cases, the beginner must look to intelligence and experience for complete success.

The toning solution mentioned in the first part of our lesson is too concentrated to be used as it is; it must, therefore, be diluted. The common practice is to use a large quantity of toning solution, and, if it is not exhausted, to keep it for after-use. This is very well for the professional photographer, who tones at regular intervals, but in the case of the amateur I think it is scarcely advisable. The solution once used is very liable to "go bad," the gold being deposited at the bottom of the bottle. I therefore recommend that the beginner estimate the quantity of toning solution that will be necessary, allowing a little margin, and that, after he has used it once, he throw it away. The waste will be very small—so small that it will not be found worth while to keep the liquid as residue. If the prints be trimmed before toning, one grain of gold is generally enough for each sheet of paper measuring 17 by 22. One ounce of the stock toning solution is therefore taken for every sheet of paper, and diluted with ten or fourteen times its amount of water.

Different samples of paper need toning baths of different strengths. As a rule, the best results will be got when it needs

about a quarter of an hour to tone to a purple, eight to ten minutes to a chocolate colour. If more time than this is needed, the bath should be made stronger; if less, weaker. Some samples of "double albumenised paper" need a bath as strong as one grain of gold chloride to five ounces of water; but an attempt should always be made first with a bath of the strength mentioned in the last paragraph.

The prints are now taken, one by one, and placed face downwards in any dish that is suitable for washing them in; a common small wooden tub is, perhaps, the best of all. They must be kept from sticking to each other, and be moved about by hand. It will be seen that the water becomes milky, from the nitrate of silver in the paper forming chloride and carbonate of silver with the salts in the washing water. At this point there should be a divergence in the operations, according to the tone that the photographer wants.

There are at this present time two favourite tones with photographers. The one is the photographic purple, the colour most commonly seen; the other is a rich warm brown. This latter colour has been affected by a man whose name ranks with those of the first landscape photographers of the day, if it be not, indeed, *the* first—Mr. Payne Jennings. So completely has the brown colour referred to connected itself in the minds of many photographers with Mr. Jennings, that I have frequently heard it talked of as "Payne Jennings' brown."

If, then, the photographer wish a "Payne Jennings' brown," his proceedings should be as follows:—The prints are very thoroughly washed. To effect this, the water must be frequently changed. When all milkiness has disappeared, the prints are laid for a few minutes in a bath containing one ounce of common salt to a gallon of water. They are then washed again with several changes of water.

If the purple tone be wished, the prints are washed for only

a few minutes. If they be in a large vessel, it is enough to turn them over once—that is to say, to remove the bottom print to the top till all have been so treated, and to run off the water. They are now placed for five minutes in a bath containing one ounce of washing soda to the gallon of water, when they receive a final moderate washing. The use of the soda is to neutralise the acid that usually exists in ready-sensitised paper, and that greatly retards toning. It (the soda) will, however, accelerate toning, even when no acid has been used in the preparation of the paper.

After either of the operations just described is finished, the prints are ready for toning. The washing is best done by the light of a candle or lamp, as such will not affect the paper. The toning must be done in feeble white light, as it is difficult to judge of colours by yellow light. It is best performed in a flat white dish at least an inch longer each way than the prints.

One print is taken from the washing water and placed in the toning, first face downwards; it is then turned face up, then again down, repeating the process once or twice, so as to allow the solution to act evenly on it. Now another print, and perhaps two or three more, are similarly placed in the solution. It will be noticed that the prints, during washing, turn to a brick red. In the toning they will turn to a brown, and gradually—at any rate, if treated with soda, as described—to a sort of violet or purple. They must be kept in constant motion. The best plan is to keep continually lifting the undermost print, and placing it on the top. At first, only a few prints should be attempted together; after some practice, a dozen or two may be in the solution at once. When many prints are toned together, it is a good plan to have two dishes of toning solution side by side, and to keep lifting the prints out of one into the other, the whole of the prints being turned over in a mass when they are all in one dish.

The colour will be noticed gradually to change. In the case of the prints which have been thoroughly washed and treated with salt, the change will be comparatively slow; it will probably, with no amount of pushing, result in a colour deeper than a brown. In this case, however, the colour attained may be relied on to change but slightly during fixing, &c.; whereas, in the case of the soda-treated prints, a certain amount of the tone will often be lost. For this reason it is necessary to go a little farther than appears at the time necessary. When it is judged that a print is toned, it is placed in a dish of clear water. It is moved about for a few seconds to get rid of the greater part of the toning solution that is in the pores of the paper, and that would make the toning proceed after it is wished to stop it. When all the prints have passed through the toning bath, they must be washed in several changes of water, being kept moving for about five minutes during each change.

Now comes the fixing. The prints are taken from the washing water, and are placed in a flat dish, into which sufficient fixing solution to quite cover them has been poured, and they are kept moving for about twenty minutes. The tone, especially when it is pretty deep, may be seen to fall off considerably when the prints are first placed in the fixing solution. It will, however, in a great measure return as the fixing goes on, and during washing and drying. After fixing, it is necessary to wash the prints most thoroughly. This is best done in running water, but if such cannot be had, then frequent changes will do. It is common to recommend washing for not less than twelve hours, but it should be borne in mind that, if the washing be so done that each print is continually brought into contact with clean water, the process will be more perfect in one hour than if the prints be merely allowed to stick together in a mass with water running on them. There are several machines made for facilitating washing, on the principle of keeping the prints in

continual motion in running water. Most of these finish the process in an hour or so. The smallest trace of hyposulphite in the prints may cause them to fade.

The thing most necessary to observe during all these operations is, that the prints be at no time allowed to stick together in a mass. If this occur at any stage, a disagreeable colour, with yellow or degraded whites, is sure to result. It is also necessary to observe that the prints be kept throughout all these processes back upwards, otherwise a fine powder may be deposited on the face of them.

CHAPTER XVII.

SENSITISING ALBUMENISED PAPERS.

The great convenience of ready-sensitised paper is, that it will keep for a very considerable length of time, either before printing, or between printing and toning. The means of preparing such paper is at present a trade secret, and when the amateur prepares his own paper, he will find that it will turn brown in from twenty-four hours to three or four days. He ought, therefore, to do his sensitising and fixing all in one day, or, at the most, within two or three days. If he has time to do this, he will probably be rewarded by superior results. I shall therefore describe the process of sensitising.

"Salted" albumenised paper is purchased—that is to say, paper coated with albumen which is impregnated with soluble chloride. This paper may be either single or double albumenised. The latter has a far higher surface than the former. It is becoming daily more popular.

A "silver bath" is made up by dissolving nitrate of silver in distilled water. The strength of the bath varies with the paper used. Any dealer in albumenised paper will state what strength of bath is best to use for the particular brand he sells. One containing sixty grains of nitrate of silver to each ounce of solution will suit most papers. Enough of this must be prepared to cover the bottom of the flat dish to be used in sensitising to a depth of at least a quarter of an inch. The dish should be half an inch larger than the paper in each direction. If much paper is to be used, it is best to sensitise in large pieces, and to cut it into sizes before printing. Professional photographers usually sensitise a whole sheet at a time.

A room lighted by a lamp or gas is the best in which to carry on the sensitising process.

The silver solution is poured into the bath, and a piece of the paper is taken by opposite corners, and with the albumenised side downwards. The paper is so held that it will first touch the surface of the solution in a line between the two corners not held by the hands. Suppose the paper held by the right-hand upper and left-hand lower corners. The left-hand upper corner is allowed to touch the surface of the solution, and the paper is lowered till it touches in a line from the left-hand upper to the right-hand lower corners. Now the two corners held in the hands are slowly lowered, first one and then the other. This sounds elaborate, but it is very simple in practice. If it be carried out properly, there should be no air-bells under the paper, but it is best to lift the sheet from the solution after about a minute, and look to make sure. If there are any, they can be broken by gently moving about the paper whilst one-half is held out of the solution.

The time of floating varies with different papers and different strengths of baths. It should be ascertained when the paper is bought. With a 60-grain bath from three to five minutes is usually ample. If the paper curls away from the solution at the edges, it may be made to lie flat by breathing on the back of it.

After the specified time has elapsed, the paper is taken up by two adjacent corners, and withdrawn from the surface of the solution very slowly, so that it drains as it is being lifted. It is now hung up by the corner to dry, a pin or American clip being used to secure it. A small fragment of blotting-paper is made to touch the lower corner immediately after it is hung up. This will adhere by capillary attraction, and collect a drop or two of solution, which would otherwise fall on the floor. It is usual to allow the paper to dry hanging up, but the writer

prefers to leave it hanging for about five minutes only, afterwards to lay it face downwards on blotting paper to dry, and to roll it up precisely as described for finished prints. It is then ready for printing, toning, &c., to be done as has been described for ready-sensitised paper.

The silver solution gradually becomes contaminated with organic matter. To precipitate this, a few drops of a saturated solution of carbonate of soda are added to the bath. This will form a fine white precipitate, which will carry down any organic matter, and will, moreover, keep the bath from becoming acid. Should the precipitate become re-dissolved through time, a little more carbonate of soda solution may be added.

The solution, when not in use, should be kept in a clear glass bottle in the brightest available light, and the black precipitate that is formed should be filtered off from time to time.

The silver solution becomes weaker through use, and it is necessary to strengthen it at intervals. Its strength can be ascertained by the use of an "argentometer," which is a cheap form of hydrometer specially graduated for grains of silver per ounce of solution. If, as the solution is used up, the quantity lost be made up from a stock solution 50 per cent. stronger than the bath—a 90-grain solution for a 60-grain bath, for example—the strength of the bath will remain fairly constant.

It is the custom with some operators to "fume" their sensitised paper. They claim that a more brilliant result is thereby gained, and that toning is more readily performed. This is so, at any rate, in the case of certain brands of paper. The process consists simply in exposing the paper to the fumes of ammonia. With those who print on a large scale, a special box, in which prints are hung on netting over liquid ammonia, is generally used; but I have been able to succeed very well with a makeshift apparatus. I shall describe this, and a method which I have found to give very satisfactory results.

A box of any kind, measuring a couple of feet or so in length and breadth, and (say) a foot deep, is taken. One of those mill-board contrivances used by dressmakers in which to pack the finery worn by the superior sex will do very well. An ounce or so of the stock solution, consisting of one part strong liquid ammonia and one part water, is sprinkled over the bottom of the box, which is then covered to a depth of several inches with crumpled paper; the sensitised paper is placed on this latter, and the lid is shut down. After things have remained so for a quarter of an hour, the paper will be fumed. Fumed paper prints somewhat more quickly than that not so treated.

In the toning and other processes that follow printing, the operations are essentially the same in the case of paper prepared as just described, as in that of ready sensitised paper. It is never necessary, however, to use the soda in the washing water. The paper will tone very easily to a purple without any such treatment. If, however, it be wished to get the brown that I have styled "Payne Jennings'" brown, it is desirable to treat the prints with salt as already described, which will make them very red.

Paper prepared as just described may be kept for quite a number of days by placing it between sheets of blotting-paper that have been soaked in a strong solution of washing soda, and have been dried. Some of the best printers prefer to use their paper before it is "bone dry." They claim that they get more brilliant results than they otherwise would. The paper may be rolled up before it is absolutely dry if it is to be used within the next few hours; or if it is to be used within the next few days, it may be placed, still quite damp to the touch, between the sheets of soda-treated blotting-paper, which will extract most of the water from it, but will leave a little.

CHAPTER XVIII.

VARIOUS OTHER SILVER PRINTING PROCESSES.

Printing on Plain Paper—On Gelatino-Citro-Chloride Paper—On Collodio-Chloride—On "Rapid" Paper—On Gelatino-Bromide Paper.

Printing on Plain Paper.

The tendency at the present day is certainly, for the most part, in the direction of printing processes that give a "matt" instead of a glazed surface, and the oldest of photographic printing processes, that of printing on plain paper, has come in for a share of favour.

At the present time there are various brands of "ready-sensitised" plain paper in the market. Little need be said of these, as they are worked, to all intents and purposes, in precisely the same way as ready-sensitised albumenised paper. It will always be found that there is less difficulty in toning plain paper than albumenised paper.

The papers that are described are generally very smooth, although without actual glaze; but I think that far the most artistic result is got by printing on actually rough drawing paper, such as Whatman's, at least in cases where the size of the work is considerable—say 10 by 8, or over. Very beautiful results may also be got by printing on various other surfaces, such as thin Japanese paper, linen, white silk, &c. The process that I now describe gives magnificent results on thick, rough

drawing paper, and very good results on almost any surface that I have tried, and that is, from its appearance, suitable to receive a picture.* The only trouble about working the process is, that all the operations must be completed within a day in hot weather, within two or three days at the most in any kind of weather. results, however, compare, I think, favourably with those obtained by any other process.

The "salting" solution is made up as follows:—

Gelatine	100 grains
Chloride of ammonium	30 ,,
Water	8 ounces
Negative varnish	2 ,, †

The solution is to be mixed in the following way:—The gelatine—any gelatine of good quality will do—is soaked in the water till it is soft, when it is melted by placing the containing vessel in boiling water. The chloride of ammonium is next added, and lastly the negative varnish is poured in a thin stream, with constant stirring, into the mixture. A white emulsion is the result.

To "salt" paper, a sheet is laid on a drawing-board or plate of clean glass sloping a little towards the operator, and the solution, still warm, is applied with a soft sponge or a ball of cotton-wool. It is applied in broad, parallel sweeps across the board, beginning at the upper edge, the paper once coated being

* This process was introduced to Japan by the writer, and it may interest readers to know the last application of it. It has been applied to producing a picture on that end of the "obi," or broad silk sash worn by ladies, that hangs down at the back. I am by no means certain that this application is justifiable on artistic grounds.

†

Gelatine	6 gr.
Chloride of ammonium	2 ,,
Water	200 c.c.
Negative varnish	50 ,,

turned through a right angle, and the process being repeated, so that the sweeps cross each other.

The surface to be salted should be marked with a pencil mark in one corner—or, perhaps, it were better to mark the back. It is not of consequence so long as the same practice is adhered to in all cases before it is salted. It is hung up to dry by American clips, and will keep in this state indefinitely, light having no effect on it.

The sensitising solution is made up as follows:—

Silver nitrate	1 ounce
Water up to	8 ounces*

To this solution there is added slowly strong ammonia till the dark precipitate formed at first is re-dissolved, leaving a clear solution. One-half of this is then taken, and nitric acid is added until it is neutral, or very slightly acid, as indicated by test papers. The two halves are once again mixed, the solution is filtered, and is then ready for use.

Sensitising is done in precisely the same way as salting, the side that has received the salt being thoroughly damped with the sensitising solution. If the paper be thick, like drawing-paper, the process should be repeated twice. The paper is sensitised once, is lain on one side for ten minutes, or long enough to let it get surface-dry, and is then sensitised a second time, and is hung up by American clips in a warm place to dry. The sensitising is best done by gas or lamp light. The paper is ready to be printed on whenever it is dry. Printing, toning, and fixing are done in exactly the same way as for albumenised paper, but that the following points of detail must be attended to. The printing should be carried a *little* farther in the frames than in the case of albumenised paper, as there is a

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* Silver nitrate	30 gr.
Water enough to make the solution up to	240 c.c.

little more loss of depth during the after-processes. It will be found that the toning proceeds with greater ease than in the case of albumenised paper, and that any colour to a very deep purple—nearly a black—can readily be got; indeed, the toning is so quick that care must be taken that it does not get beyond control. The toning solution may generally, with advantage, be somewhat more dilute than for albumenised paper, and need never approach the strength sometimes necessary to tone highly-glazed double albumenised papers.

Lyonel Clark's platinum toning process—to be described in the chapter on "Platinum Processes"—lends itself particularly to the toning of paper prepared as described. Indeed, all who intend to go in for printing on plain paper should read Mr. Clark's excellent book on the process.*

Gelatino-Citro-Chloride Paper.

Recently, paper coated with an emulsion of chloride of silver together with some organic salt of silver in gelatine has come pretty widely into use in place of albumenised paper. It has certain decided advantages. Thus it keeps considerably better than the best "ready-sensitised" paper that I know of; it prints more quickly by some two or three times; it gives a very vigorous image, so that, whilst it is not well suited for printing from very strong negatives, it gives excellent results from the ordinary run of negatives, and is particularly useful for printing from such as are too thin, giving results with which prints on albumenised paper are not to be compared; and lastly, there are several reasons—into which I cannot go here—for believing that the results are much more permanent than those on albumenised paper.

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* "Platinum Toning," by Lyonel Clark (Hazell, Watson, and Viney, Ltd., 1, Creed Lane, Ludgate Hill, E.C.).

The paper is printed in the ordinary way, allowance for reduction of intensity by after-processes being made, just as for albumenised paper. With the paper are always issued instructions for toning, but the following may be taken as a typical formula:—

Water...	10 ounces
Chloride of gold	3 grains
Sulphocyanide of ammonium ...	100 ,,
Hypcsulphite of soda	5 ,, *

The chloride of gold is mixed in one-half of the water, the other two salts in the other, and just before toning begins the former is poured into the latter, a red precipitate being at first formed, which is quickly re-dissolved.

The gelatino-chloride paper takes up much more gold in toning than does albumenised paper. The quantity given above will probably serve to tone only a sheet and a half of paper. It may, however, be used for two sheets, and, as the toning operation flags, a little more gold chloride may be added.

The prints are washed for about five minutes before they go into the toning solution. When there, they will probably turn first of all to a very sickly colour, but will eventually become brown, then purple. The toning must be carried much farther than appears necessary judging by surface colours only. It is best to judge by transmitted light, bearing in mind that the eventual surface tone will be a little deeper than the colour seen by transmitted light, and therefore toning till the prints appear quite over-toned by reflected light, a little under-toned by transmitted light.

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* Water	400 c.c.
Chloride of gold	·25 gr.
Sulphocyanide of ammonium...	8 ,,
Hyposulphite of soda	·4 ,,

The prints may go directly from the toning to the fixing bath, where they remain for ten minutes, when they are washed for half an hour or so in continually changing water, after which they are treated for five minutes in a five per cent. solution of common alum, and are again washed.

Care must be taken not to allow a warm finger to remain for any length of time in contact with the film at any one place, at any rate before the alum bath is reached, otherwise the film will be melted, and a spot will be the result.

A very fine effect is got by drying such prints in contact with glass. Clean plates of glass are prepared by rubbing them with a piece of flannel that has been dipped in a solution of a few grains of beeswax in an ounce of benzine, then polishing them with French chalk, removing as much of this material as possible with a dry cloth, and squeegeeing the prints down on them. When dry, they strip from the glass with a beautiful polish. If it be wished to mount such prints, a sheet of very thin pasteboard is glued to the back of each whilst it is still damp on the glass, and all is allowed to dry together.

Collodio-Chloride Printing.

This process corresponds very closely with the last described. Indeed, it is almost precisely the same, except that collodion forms the medium for holding the sensitive salts instead of gelatine. The collodion process is of much older date than the gelatine, and has for long been practised by a few, but it is only on account of the recent introduction of the ready-made paper on a large commercial scale that the process has become at all popular.

There is very little to say in favour of one process as against the other, except that, with the collodion process, there is not the danger that there always is with the gelatine process in very hot weather, that the film will melt off in the toning bath,

and, further, no alum bath is necessary, and of course that amounts to a saving of trouble.

The working of the collodio-chloride is practically the same as that of the gelatino-citro-chloride just described, but that the alum bath is not needed. Full instructions are, however, always issued with the paper, and should be attended to.

Rapid Printing Papers.

The end of the year 1884 saw a great stir in the photographic world, on account of the announcement that a new printing paper was to be brought out that would need an exposure many hundred times less than albumenised paper needs, and that would yet give warm-toned prints.

Messrs. Marion and Co. were the first to make the announcement. Their lead was rapidly followed by Mr. Warnerke and Messrs. Morgan and Kidd.

It was easy to see, from the appearance of the paper, that it was coated with a gelatine emulsion, and it soon became an open secret that the haloids used were chloride, bromide, or a mixture of chloride and bromide of silver.

The method of working the paper is briefly as follows :—

An exposure is made in a printing-frame in the ordinary way, except that only a second or two is given in the case of diffused light, or in the case of an ordinary gas-light, with a distance between the light and the flame of eight or ten inches, anything from a minute or so to half an hour, according to the density of the negative and the effect wished.

The image is not visible if exposure has been correct, unless the negative is one with very strong contrasts. In such a case there may be some slight trace of an image in the deepest shadows. The absence of a visible image, of course, makes the timing of the exposure a thing needing some judgment. There is, however, fortunately, considerable latitude allowable.

The paper is developed when it is taken from the frames. The developer may be either very weak and much restrained ferrous oxalate, ferro-citro-oxalate, or hydroquinone. Mr. Arnold Spiller further mentions that his hydroxylamine developer gives good results. With the papers there are, of course, sent out full instructions for mixing the developing solutions, and so forth.

The development of the print is an operation needing considerable judgment. The image must be closely watched, and the print must be removed from the bath almost before it has got as dark as it will be finally needed. If the exposure has been right, the colour of the print at this stage will be a dullish red. If the exposure has been too short, it will be a greenish-black; if too long, the image will be flat and lacking in vigour. Several prints may be developed at one time, but not very many. Whenever the print is taken from the developer it must be washed in several changes of water. After this it is immersed for a quarter of an hour in a saturated solution of alum. It is then washed again, when it is ready for toning. The same formula which is recommended for albumenised paper may be used, but its action is slow with the rapid paper. If, however, it be made of double the strength mentioned on p. 143, and there be added to each pint of it four grains of chloride of lime, the toning will go on rapidly enough. The toning needs to be continued till the surface of the print is quite purple, and if any but a very warm brown tone be required, for some time longer. The time to stop toning is best judged by looking through the print at a light.

After the prints are toned, they are washed and fixed in the ordinary manner. It will be noticed that the tone almost entirely vanishes in the fixing bath. It returns to a great extent on drying.

Mr. Warnerke recommends that toning and fixing be done

in the same bath by adding a little chloride of gold to the hyposulphite solution. A considerable saving of time is effected by this way of working. The prints are washed after fixing just as albumenised prints are. They may be mounted in the usual manner, and rolled or burnished if wished. A very brilliant effect is, however, produced by drying them in optical contact with glass exactly as described for gelatino-citro-chloride prints.

Gelatino-Bromide Printing.

This process is, perhaps, more used for enlarging than for anything else; but it is certainly also used to a great extent for direct printing. Paper is coated with gelatino-bromide emulsion that differs in no essential from that used for coating plates, but that it is generally much slower. A short exposure to artificial light is given in a printing-frame, and the print is then developed in the same way as a plate.

The prints got by the process are of an engraving black, somewhat resembling platinotypes. Indeed, it is a curious thing that, when platinotype was in its earlier days, the great fault that was found with it was that the prints did not look like ordinary photographs. A recent boast of gelatino-bromide printing is, that it gives results that cannot be distinguished from platinotype.

The sensitive side of the paper may always be recognised by the fact that the edges curl in a little towards it. It is impossible to give any precise instructions as to time of exposure, as different brands of paper vary greatly in sensitiveness, and the exposure will vary greatly with the negative; but it may be said that ten seconds at one foot from an ordinary gas burner will represent the exposure with paper of average sensitiveness, and with a negative of average density.

Development may be done either with ferrous oxalate, pyro and sulphite of soda with carbonate of soda or potassium, or

with hydroquinone, or with eikonogen. Ferrous oxalate, made distinctly acid with citric or some other acid, and somewhat diluted, is generally preferred. The pyro developer, given in the first chapter on development, may, however, be used. The carbonate of soda or carbonate of potash hydroquinone developer (mentioned in Chapter XII.) may be used.

Whatever developer is used, the paper is first soaked in clean water till it is limp, and is then laid on the bottom of a developing dish, when the developer is poured over it. The action must be watched very closely, and the developer must be poured off immediately that the print appears dark enough, as there is no loss of strength during after processes. The print is lightly rinsed in water, and then is placed in a two per cent. solution of citric or acetic acid. It remains there for five minutes or so, and is then thoroughly washed, and is fixed in a *clean* ten per cent. solution of hyposulphite of soda. It is just possible to see the process of fixing by looking through the paper, but it is not easy; and, moreover, it is advisable to leave the print in the hypo solution for much longer than the minute or so that is necessary to effect fixing. Ten minutes will be enough; but, if there are several prints in the bath at the same time, care must be taken that the solution has free access to all of them.

The prints, after fixing, have only to be thoroughly washed and to be dried—operations that may be conducted in daylight.

It will be found that, as a rule, the best results will be got on gelatino-bromide paper from negatives that are rather too thin for ordinary silver printing.

CHAPTER XIX.

DEFECTS IN SILVER PRINTS, AND REMEDIES.

The following are the defects most commonly met with in silver prints; I give the remedy in every case where I know of one:—

The Prints are Yellow in the Whites—or, to speak more strictly, in the parts that ought to be white.

I leave out of consideration the case where the paper has been kept too long before printing, or between printing and toning, and has turned brown, for, of course, in such a case, it is unreasonable to expect pure whites, although the fixing baths will very considerably reduce the discolouration.

Yellowness appearing in the whites of prints on albumenised or plain sensitised paper after the manipulations of washing, &c., have begun, may be due to any one of several causes. If the prints be allowed to stick together in masses in the first washing water, yellowness will be the result. The action of too much white light on the print at any stage before the fixing will have the same effect. So will any of a great number of foreign substances—notably hypo—in the toning bath, or in the washing waters used before toning. Lastly, acidity of the fixing bath may produce the yellowness. It is, as has already been stated, advisable to add to the fixing bath, for silver prints, as much ammonia as will cause it to smell slightly of the alkali. The remedy in the other cases is evident.

In the case of gelatino-citro-chloride paper, or of "rapid paper," yellowing is generally due to insufficient washing between the alum and the fixing baths.

Yellowness in bromide prints is due to an insufficient use of the acid bath, some of the iron of the developer remaining in the pores of the paper in an insoluble form.

Mealiness in prints on albumenised paper is a term that should be used only to denote a peculiar mottled appearance of the surface of a print, but that is often used to describe any lack of brilliancy evidently not due to lack of contrast in the negative. The true mealiness is caused by weakness of the silver bath. It is generally accompanied by *lack of contrast* due to the same cause, and often to *loss of brilliancy of the surface of the print,* which may be due either to the same cause, or to alkalinity of the bath. Alkalinity is a condition of things not likely to arise in the sensitising bath—on the contrary, acidity is the fault to fear most; but if the defect mentioned be observed, the bath may be shaken up, till it is cloudy, with the carbonate of silver produced by the addition of a small quantity of carbonate of soda to it. A saturated solution of citric acid may then be added till the carbonate of silver is dissolved entirely, or at least partly, when a little more carbonate of soda may be added.

Marble-like markings on the paper are due to scum on the sensitising bath. They are almost sure to occur in the case of the first piece of paper sensitised, unless the surface of the liquid be cleared by passing the edge of a piece of paper over it.

In the case of plain paper sensitised as described in the last chapter, markings differing not very much from those just mentioned will result if the brushing on of the sensitising solution be not very carefully done.

Refusal of the Print to Tone.—The print will refuse to tone, or will tone only slowly to an unsatisfactory colour, if the sensitising bath be acid, or if it be much contaminated with organic matter. The acidity may be prevented by adding carbonate of soda as suggested. Organic matter is got rid of by frequent sunning.

The toning, and not the sensitising, bath may, however, be at fault. Sometimes the gold is spontaneously thrown down from the bath. In this case it will be seen in the form of a fine black precipitate clinging to the sides and bottom of the bottle.

If the toning bath be acid, it will not tone in a satisfactory manner. Its condition may be ascertained with test paper, and if it be found to be acid, it may be made neutral or slightly alkaline with bicarbonate of soda.

A common cause of slowness in toning is simply lack of gold in the toning bath. A great deal of the chloride of gold sold to photographers is much adulterated, in the sense that it does not contain the quantity of gold that there would be even in the definite double chloride of gold and sodium. This is of necessity so in the case of the cheaper brands, unless we assume that the makers actually elect to sell gold at less than the sterling value.

Chloride of gold should not be bought without a guarantee that each fifteen-grain tube contains seven grains of metallic gold.

A *Loss of Tone in the Fixing Bath* sometimes occurs with plain or albumenised sensitised papers when the prints have not been sufficiently washed before the toning operations. As has already been indicated, there is always a loss of tone with "rapid" and gelatino-citro-chloride papers, unless the toning process has been carried farther than might appear necessary at first.

Unevenness of Tone almost always has its origin in the sticking of the prints together in the toning bath; or sometimes from their being allowed to stick together in the washing waters used before toning, whereby they are unequally washed. The remedy, of course, is to prevent them from sticking together in the washing water or the toning bath. Gelatino-citro-chloride paper almost always *begins* to tone very unevenly, the print, in

fact, for a little time having a most hopeless appearance. Generally, however, the tone becomes equalised after a minute or two. Even if it does not, the fact that it is practically impossible to overtone prints on this paper—that after a certain stage is reached the toning seems simply to stop—makes it possible to wait till any patches toned less than the rest make up.

Bronzing is a phenomenon that makes its appearance only in the shadows of prints got from negatives showing very bold contrasts, and it is met with only in the case of sensitised, albumenised, or plain paper, or of gelatino-citro-chloride paper. It is seen on looking at the print from a certain angle. The appearance is that of a metallic lustre in the deepest shadows. It is but seldom that it does not disappear in the fixing bath. If it do not, the fact proves, in the case of sensitised, plain, or albumenised paper, that the sensitising bath has been too strong.

Round White Spots in the prints are due to air-bubbles under the paper during sensitising. The remedy is evident.

Metallic Spots sometimes make their appearance on the paper before it is put into the printing frame. They are dark, of metallic lustre, of size from that of a pin's head upwards, with irregular outline. They are almost always due to particles of iron in the paper itself, and are, of course, beyond the control of the photographer; but they are sometimes due to particles of iron in the blotting-paper or blotting-boards, between which many photographers partially dry their paper after sensitising.

Insensitive Spots or Patches show themselves sometimes on prints on bromide paper that has been kept too long, especially in a damp place. There is no remedy but working out by hand. These *patches* are to be distinguished from the small round white spots with well-defined outlines due to air-bubbles in the developer.

CHAPTER XX.

PLATINUM PROCESSES.

I HAVE said that silver printing will probably still be largely used by many. It is, however, now hard run by several processes, and, perhaps, by none so hard as by the process known as the platinotype. This, although of but comparatively recent date as a commercial printing process, has nevertheless become a great favourite, and appears to be ever gaining in the estimation of the public. Indeed, it may be said that, in England at any rate, it is now the process most worked of any by those who aspire to artistic results. This is certainly not without reason, for it is in many respects the most attractive of all printing processes. It has several very great advantages over the silver process. Firstly, and chiefly, the results are permanent; secondly, they are, to an artistic eye, far more pleasing than those of silver printing—the colour is an engraving black, and the surface is not glazed, but matt, like drawing paper; thirdly, the process is far more easy to work. The time taken for printing is not quite half what is necessary for albumenised paper. There is no toning, nor is there any prolonged washing.

There are, at present, several somewhat different platinotype processes worked in England. The two that are most popular are both the invention of Mr. W. Willis, and are patented. The materials can, at the present time, be had from the Platinotype Company, of 1, Charlotte Street, Bedford Square,

London, W.C., only, and as these are always issued with instructions of the most precise nature, a description much shorter than the importance of the process would justify will be sufficient here.

The Hot Bath Process.

The paper for this process is coated with a mixture of a salt of iron and a salt of platinum. The one thing that requires great and constant attention is to keep this paper thoroughly dry. It has to be kept in a metal case with a small quantity of calcium chloride, when not actually in the frames, and when in these, it is necessary to keep a thin sheet of india-rubber behind it.

Printing is done in the usual way, but the image that appears is not brown, or purple, but it is a faint greyish-yellow colour. This at first is puzzling, but one soon learns to judge of the exposure as accurately as with silver. The prints have to be developed by floating them on the surface of a hot solution, containing 130 grains of oxalate of potash to each ounce of water. A flat iron dish is the best to operate with. The solution is kept at a temperature of 170° to 180° Fahr., by means of a spirit lamp or Bunsen burner. The process of development is a most beautiful one. The print, before it is developed, is only just visible. It is placed thus on the surface of the solution, and in a few seconds there is removed a picture perfect in colour and gradation of tone. It is possible to compensate for a considerable amount of over-exposure by using the developing solution cooler than is mentioned above.

The developed print is transferred to a dish containing one part of hydrochloric acid in sixty parts of water. Hence it passes to a second, and then to a third similar bath, remaining a few minutes in each.

It is then washed for about a quarter of an hour in several

changes of water, after which it is finished. Negatives which are just somewhat too dense for silver printing give excellent results with platinum. Any negative, however, which will give a good silver print, will give a good platinum print.

The Platinotype Company have introduced a paper which gives a warmer colour than the one of which we have been writing. The tint got on it is somewhat of the nature of a sepia brown.

The Cold Bath Process.

This is another outcome of the genius of Mr. Willis. In the process just described there is some trouble in having to be so exceedingly careful about the dryness of the paper, and in having to use hot solutions. The trouble is not, certainly, serious, but there is the farther fact that, with a given negative, there is but little latitude in the effect producible, and that, moreover, the negatives needed for the process are, on the whole, a little denser than those that do best for common silver printing. With the new "cold bath" process there are none of these difficulties. The paper contains an iron salt only, and the *developer* contains the platinum that is necessary to form the image. The paper, if stored for any length of time, has to be kept in calcium tubes, but no particular care is necessary to prevent slight dampness in the printing frames. In fact, some trace of dampness, such as paper will absorb from the atmosphere in a few minutes, or in very dry weather in an hour or two, is necessary to get the best results, and it is on account of the fact that the effect is different according to the length of time that the paper remains out of the calcium tube before development. Thus, if the print be quickly made, and be developed at once, the contrast will be great, the half-tone but slight, and this is what is wanted in printing from a thin negative. If, on the other hand, the print be put on one side for a few hours after printing, there will be less contrast and

more half-tone, and thus it will be possible to get a harmonious result from an over-dense negative. Farther variation in result is producible by variation in the mixing of the developing solution.

As in the case of the "hot bath" process, the Platinotype Company issue such full instructions with the paper that there is no need to do more than give the barest outline of a description of the manipulations.

The paper has about the same appearance, and is printed in the same way, as the hot bath process, but that no rubber sheets have to be used in the printing frames. The developing solution, as already indicated, contains the platinum, and is used cold.

The image is, I think, a little brighter, and therefore more easily judged of in the printing frame, than in the case of the hot bath process. As has been indicated above, the prints are developed at once, or after they have lain loose in a drawer or box for any time up to three or four hours, according to the nature of the negatives that they are made from, or the nature of prints that are wished. They are then floated, one at a time, on the developing solution. A print is allowed to float for a few seconds, and is then removed and held in the hand. It will be observed that the darkening is much slower than in the case of the hot bath, and that it proceeds to a certain extent whilst the print is held in the hand. It may, however, be necessary to float for two or three times to get sufficient depth. I have found it possible with this process to get bright prints from negatives so thin that they would scarcely give tolerable prints on albumenised paper. In any case, the process must be watched closely, and the moment that the right result is got, the picture must go into the first of three baths of dilute hydrochloric acid made up as for the hot bath process.

It says well for the keeping qualities of this paper that I have had it sent from the Platinotype Company, of London, to

Japan, and that it has arrived, after a journey of more than two months, in perfect condition.

Sepia Platinotypes.

When the platinotype process was first invented, most of those with artistic taste particularly admired the fine black colour of the prints, and this is the feature now most generally admired; but at first there was a demand from very many for a colour warmer than that got by the ordinary hot bath process, and there is still some demand for such a colour. To meet this the Platinotype Company issued a paper to give a sepia tint. The writer has seen excellent results on this paper, but has not used it himself.

The following is extracted from the instructions issued by the Platinotype Company:—

"With few exceptions the method of carrying out the operations is the same as for the 'black' kinds of platinotype paper. The *following points* should be attended to:—

"The 'sepia' paper is more easily affected by faint rays of light, and, therefore, increased care must be taken when printing. It does not remain in its best condition for so long a period as the 'black' varieties; there is also a tendency in paper which has been kept to lose some of its warmth of colour.

"To develop, add to each ounce of the solution of potassic oxalate (130 grains in each ounce), one or two drachms of the special solution supplied for this purpose, and proceed as described in the section devoted to development by the hot bath. The object of the special solution is to give purity to the whites.

"As regards temperature, over-exposure cannot be corrected by cooler bath, as in the case of 'black' prints.

"Discolouration of the whites is due to one of the following causes:—1. Want of sufficient 'special solution' in the developer; 2. Too much exposure of the developing solution to light;

3. Use of a dish in which the enamel is cracked so as to expose the iron; 4. Paper kept too long; 5. Exposure of prints to too much light while clearing.

"The developing bath, after use, must be kept in the dark. This bath must not be used for 'black' prints.

"The prints are cleared in an acid bath of 1 part hydrochloric acid (s. g. 1·16) to 60 parts of water.

"As the 'sepia' prints, unlike the 'black' ones, may be affected by light *when in the acid bath*, the lights being stained and degraded, the prints at this stage must be manipulated in a *very weak* light. The prints are damaged by being left abnormally long in the acid baths.

"The subsequent operations are the same as for the other kind of paper."

Pizzighelli's Printing-Out Platinotype Process.

This process is now several years old. It is the invention of one who has done an immense deal in the matter of investigating various platinum processes. The title indicates what is the distinguishing feature of the process, namely, that the image comes fully out in the printing frame. This effect is brought about by having in the film with which the paper is coated both the printing and the developing chemicals used by Willis in his hot bath process.

My experience of this process is extremely small, being limited to such experiments as I could make with a few pieces of the paper sent by mail by Mr. George Davison. The following can, however, be stated with confidence. The paper prints much more slowly than that of Willis, but, the image being fully visible in the frames, there is little chance of any misjudgment of exposure. It would seem that it is necessary to allow the paper to absorb a little moisture before printing, so that the reduction of the platinum may take place.

After the print has become deep enough, nothing is necessary but to pass it directly to the hydrochloric acid bath. Printing is thus, by this process, reduced to about the greatest degree of simplicity and certainty that is possible.

I may mention that the few little bits of paper that I mention as having been sent to me by Mr. Davison were wrapped only in a piece of yellow paper, but that they arrived in Japan by mail from England in perfect condition.

The Platinum Processes of Messrs. Valentine Blanchard and Lyonel Clark.

These processes have both given remarkably good results in the hands of the writer. They are really processes of silver printing followed by toning with platinum, and ought, perhaps, to have been treated in the chapter on various silver printing processes. It seems, however, that the conversion of the image into platinum is much more nearly complete in these processes than is the conversion to gold in the older silver printing processes. Moreover, as in the announcements and descriptions of both processes, more emphasis has been laid on the platinum than on the silver, I insert them here.

The details of Blanchard's process have not been published, but all materials for working it, and information about it, can be had from Mr. Blanchard.

The chief feature of this process is the manufacture of a plain sensitised paper that keeps very fairly well—several months in ordinary circumstances—and that is particularly amenable to platinum toning. The writer has used considerable quantities of this paper, but has toned all his prints with Clark's toning bath (described below). This bath works very well with Blanchard's paper, but so rapidly does this paper tone that it is advisable to dilute the bath here given with two or three times

as much water as is mentioned, otherwise the process will be beyond control.

The following is a short description of Mr. Clark's process.

Prints are made in silver on any kind of plain paper that is suitable for photography. The process described in the beginning of the next chapter will be found suitable. These prints are to be made fully as dark as for ordinary gold toning.

The following solution is now to be made up :—

Chloro-platinite of potassium* ...	60 grains
Nitric acid	about 30 to 40 minims
Water	32 ounces†

The prints are to be washed *thoroughly* to remove the last trace of free nitrate of silver, and are then to be toned by placing them one at a time face downwards in the above solution. In very cold weather this solution, like the ordinary gold toning solution, should be warmed to about 70° or 80° Fahr. The toning is very rapid. The solution given above is to be used when a black colour is wished, the toning being pushed till such colour is reached. If a warm brown is wished, it is advised that the solution be diluted with three or four times its amount of water, so that the toning is sufficiently under the control to stop the action when a brown colour is reached. In this case several prints are placed in the solution at a time.

The prints are to be washed, fixed, and again washed like ordinary silver prints.

A curious brownish colour much admired by some is got in toning albumenised paper by this process.

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* This is the platinum salt issued by the Platinotype Company for the "cold bath" process, and it can be got from them.

†

Chloro-platinite of potassium	4 gr.
Nitric acid	2 to 3 c.c.
Water	1 litre

CHAPTER XXI.

VIGNETTING—PRINTING OF SKIES INTO LANDSCAPE NEGATIVES.

The effect produced by what is known as vignetting is one that is admired by many, especially when it is applied to a suitable picture. It is so easy to do it that it is a pity the amateur should not be instructed in the method.

Innumerable dodges have been invented for producing the vignette effect; some have been patented, some have been sold as secret processes; but, after all, the simplest way of all seems to give as good results as any other. An opening is made in a piece of cardboard or other stiff material. This opening is made of the shape that the image is to be, but a little smaller, and the cardboard is fixed in front of the printing-frame whilst printing goes on in diffused light, or, better still, with a piece of tissue paper over the opening cut in the cardboard.

The softness of the vignette depends on the distance between the negative and the cardboard. The greater the distance, the broader the portions through which there is shading off.

With most printing-frames it is sufficient to fix the cardboard —with drawing pins or otherwise—to the front of the frame. It is my practice, if this arrangement does not give sufficient softness of shading, to pinch the edges of the opening upwards with my finger and thumb.*

* Mr. Lyonel Clark has recommended thin sheet lead for making vignettes. It will be found very convenient, as the edges of the opening can so easily be pinched up.

It is often necessary to modify the vignetting board by cutting out bits here and there, or by cutting new boards entirely, a trial print being made after each modification before the most satisfactory results can be got. Bits of spoiled paper, otherwise useless, may often be made use of for such trials.

The negative that lends itself best to the production of vignettes is one full of detail, and giving a somewhat soft print.

Printing Skies into Landscapes.

A white sky in a photographic print is, almost without exception, from an artistic point of view, an abomination. Few beginners would believe the change that can be wrought by printing a bit of cloud into a sky otherwise quite white. A picture is often *made* by this simple means.

The printing of clouds into skies is by no means difficult. The first requisite is, of course, a selection of cloud negatives. These are easily enough made. Exposures are given on suitable looking clouds, the lengths of time given in the tables under the heading "Sea and Sky," or something a little shorter, being suitable in most cases.

The clouds, to be useful, must be well chosen. The most brilliant-looking clouds are almost always such as are near the sun; but although these are often so beautiful that they will make pictures in themselves, they are comparatively little use for the purpose of printing into landscapes, for it is seldom that landscapes are taken looking towards the sun, and it is essential that the clouds printed into a landscape should be lighted from the same point that the landscape is.

A series of cloud negatives, then, of all kinds that have any beauty in them, and lighted in all different ways, but especially from the side, should be made. As already mentioned, those taken on paper or films have the immense advantage that they

can be printed from either side, thus virtually being each equal to two negatives, one lighted from each side.

Now as to the printing of such clouds into the landscapes. It is almost essential that the skies should be quite white in the first place. If they be not naturally dense enough in the negative, they must be *masked* by colouring the sky in the negative with some opaque colour, great care being taken in following the horizon line.

I shall take first of all the case of a landscape with a horizon pretty nearly straight, as this is the simplest. It is convenient to use a printing frame considerably larger than the negative, so that there is room to make adjustment between it and the print.

The print—with sky white—is placed on the negative that has been selected as most suitable, and is so adjusted that the clouds fall into the position that seems best. The back of the printing frame is now adjusted, and the focussing cloth is loosely thrown across one side of the frame, so as to cover the landscape part of the photograph. Printing is done in the shade, and the focussing cloth is slightly shifted from time to time, so that the sky, white or nearly so at the horizon, gradually darkens a little higher up, the clouds showing. When the sky is printed as dark as is just necessary, the print is finished. As a rule, none but those who have very considerable artistic taste and knowledge, and much practice, should risk printing in skies other than very light—no more, in fact, than to give an indication of clouds.

If dark objects project into the sky they may be disregarded; the clouds printed across them will not show.

If, however, light objects project into the sky it is necessary to mask them, so as to protect them from the light passing through the cloud negative. The best way to do this is to take a print from the landscape negative. This, untoned and un-

fixed, is cut with a pair of scissors or a sharp pen-knife, so as to follow the line of demarcation between landscape and sky, care being taken to cut a shade *within* the landscape—that is to say, to cut a trifle off the landscape. This mask is now fixed with two wafers at its lower corners on to the cloud negative, so as to cover all but what is to be printed into the landscape. The print has now to be very carefully adjusted over this, when all is ready for exposure.

Even when the horizon is straight, if it is wished to bring the clouds quite down to it, masking must be resorted to.

A simply "graduated" sky—very much better than a blank white one, as good as anything for some subjects—is made by exposing the upper or sky part of the print to light, whilst a sheet of cardboard is held over the landscape part, and is kept in motion so as to *graduate* the darkening.

Cloud negatives can be bought from most dealers, but many will have conscientious scruples about using them, and afterwards exhibiting the prints as their own productions.

CHAPTER XXII.

MOUNTING, ROLLING, BURNISHING, AND ENAMELLING PRINTS.

If it be wished to keep prints unmounted, it is somewhat difficult to keep them from curling up as they dry. The writer has found the following to be a convenient manner of drying prints and treating them afterwards.

The prints, as they are taken from the washing water, are allowed to drain for a few seconds, then blotted off with clean white blotting-paper, and laid to dry, *face downwards*, on a table covered with a clean cloth or with clean white blotting-paper. When they have laid till they are dry to the touch, one of them is rolled tightly on a wooden roller, albumenised side outwards. The end of a second print is caught under that of the first, which is nearly rolled up, and so the rolling goes on, each print being caused to catch up another just before this first is completely rolled up. The roll of prints is laid aside for a few days, after which they will show very little inclination to roll up *face inwards*, as they otherwise would. They may be further improved by hot rolling with a plate and roller machine.

Mounting Prints.

After the prints, by any of the processes described, have been washed, they may be mounted at once before being dried. There are various ways of mounting. The following is one that has

been adopted by the writer:—A thin glue is made by soaking an ounce and a-half of hard gelatine in ten ounces of water. When the gelatine is quite soft, the temperature is raised till it is melted. Five ounces of methylated spirit, and one ounce of glycerine, are now added.

In mounting, a squeegee—a strip of india-rubber with a wooden handle—is used. This should be somewhat longer than the breadth of the widest print to be mounted.

The prints are laid face upwards in a flat dish filled with *hot* water. A mount is taken and is brushed over with the glue on one side. A print is at once laid on the glued side of the mount. It may easily be slid about to adjust its position. When this is right, the squeegee is passed quickly over the surface, first in one direction then in the other. By this means the unnecessary gelatine is driven out. A clean cloth is dipped in hot water, and the gelatine round the edges is quickly wiped away.

A method that will be preferred by many is the following:— The prints are removed from the washing water, and are laid back upwards in a mass on a clean glass plate. A thin paste of pure corn starch is made, the top print is brushed over with this, is lifted, placed immediately in position on the mount, and is squeezed down with a handkerchief or other soft cloth. If, as is customary with carte and cabinet prints, they are mounted with a narrow margin, the adjustment of the paper on the mount may be done by eye; but if, as is customary with large prints, especially landscapes, a wide margin is adopted, the position of two opposite corners of the print should be marked on it with a needle point.

Rolling and Burnishing Prints.

Mounted prints, unless they are to be enamelled, should either be rolled or burnished. Rolling consists in passing the prints between two polished metal rollers, or a polished roller and

plate. The roller or plate may, or may not, be heated. Burnishing consists in *drawing* the print over a bar of polished steel, that is always heated, the print being first treated with a solution of four or five grains of Castile soap in an ounce of methylated spirit, rubbed on to the surface of it with a piece of flannel, and allowed to dry. A far higher polish is given by the burnisher than by a rolling press; indeed, the polish given by the burnisher is by many considered to be offensive. It is not usual to burnish prints much larger than cabinet size. If the amateur do not possess either a burnisher or a rolling press, he can usually get his prints burnished or rolled by sending them to some neighbouring photographer.

Enamelling Prints.

The modern school of "naturalistic" or "impressionist" photography affects great contempt for the "meritricious" gloss given by enamelling. There is no doubt that, in the main, they are right, and that the tendency towards matt surfaces in photography has done much good; but I cannot see why enamelling should *never* be permissible. I imagine that those who affect so much scorn for enamelling in photography would not fail to admire good porcelain enamel. At any rate, it has long been the writer's opinion that, if there is to be a gloss at all, it should be a good one, and not the sort of half-hearted gloss that albumenised paper not rolled, or burnished, or enamelled, gives. He, for this reason, gives instructions for enamelling.

A cheap collodion is sold as "enamel collodion." To enamel, all that is necessary is to take plates of glass somewhat larger than the size of the prints, and free from all scratches, to clean them, polish them, and to coat them with enamel collodion. The coating is done in exactly the same way as the negative is varnished. The collodion film is then washed till all greasiness disappears, when a wet print is squeegeed on to it. When the

paper and film have dried, they may be stripped from the glass, when it will be found that the print has an enamel-like surface.

A still more brilliant effect is got by allowing the collodion to dry, by warming the plate, pouring over the collodion a five per cent. solution of gelatine in water, squeegeeing the print over this, and allowing the whole to dry. There is, however, some chance that the print may refuse to leave the glass.

If enamelled prints are to be mounted, they must either be mounted by the edges only, with fairly thick glue, these edges being afterwards covered by a cut-out mount placed in front of the print; or a sheet of very thin cardboard may be fixed on the back of the print whilst it is still on the glass, and before it is dried. If an attempt be made to mount enamelled prints in any of the ordinary ways, the surface will be spoiled.

It will be understood that prints by either the gelatino-citro-chloride, or the "rapid" process, dried in optical contact with glass, as described in a former chapter, are already enamelled. Bromide prints *may* be enamelled in the same way.

Mounting Prints in Optical Contact with Glass.

If prints are to be placed behind glass, there is no object in stripping them to get an enamel surface. The best thing is to fix them securely to the glass in optical contact. The glass is simply cleaned, the treatment with French chalk and collodion being omitted. The print is placed in warm water, the glass is warmed, is coated with a five per cent. gelatine solution, and, whilst this is still liquid, the print is squeegeed on to the glass.

Such prints generally look best framed without margin; but if a white or tinted margin is wanted, a plate of suitable size is used, the print is mounted in the middle of it, and afterwards a sheet of white or tinted paper, the whole size of the plate, is squeegeed over the back of the print.

CHAPTER XXIII.

TRANSPARENCIES—LANTERN SLIDES—ENLARGING AND REDUCING.

The particular form of print known as a transparency is a very attractive one. It differs from an ordinary print in as much as it is seen by transmitted, not reflected, light. It is usually on glass, and is seen by being hung up against a window, or wherever there may be a strong source of light behind it. A transparency differs from a negative only in as much as the shades of nature are correctly represented, instead of being reversed.

Very fair transparencies can be made on the ordinary dry plates used for negatives, especially such as are rather slow. One of these is placed behind a negative in a printing-frame, and an exposure, which may vary from five seconds to a minute, according to the density of a negative, is given at a distance of (say) three feet from the gas-burner.

Development may be either by ferrous oxalate, pyro with carbonate of soda or potash, or with hydroquinone. In fact, what is said in a former chapter on the developers suitable to gelatino-bromide prints will apply also to transparencies on gelatino-bromide. It is necessary to stop development whilst the whites still remain quite pure, and to use fresh mixed "hypo" in fixing.

Gelatino-bromide plates are now specially made for transparency work. They differ from ordinary plates chiefly in being much slower. They give excellent results if a black colour only be wished.

Some time ago, gelatino-chloride plates specially prepared for the making of transparencies became an article of commerce. They give very beautiful results, a variety of tints being obtainable.

Of these plates it is necessary to say but little, as the manner of development is quite similar to that which has been treated of already, whilst the particular solutions to be used are fully described in the instructions which are issued with the plates.

In appearance, the plates are much more transparent than gelatino-bromide plates. Indeed, so transparent are they that it is often difficult to tell which side has the film on it. The chloride plates are far less sensitive than the bromide, and can consequently be worked in a much more brilliant light. In fact, almost any amount of yellow light may be admitted, or an ordinary uncovered candle may be used, if a little care be exercised in working.

The writer has always found that he required to give considerably longer exposure than that mentioned in the instructions. Undoubtedly the most convenient way of exposing is by burning a few inches of magnesium wire in front of the negative. In the writer's experience, three inches of wire is a good amount to burn, the distance at which it is held from the negative varying from eight inches to two feet, according to its density and the colour of transparency required. The longer the exposure, the developer being adapted to it, the warmer will the colour of the transparency be. It is possible to get any colour of image from a black to a claret red.

The developer used is ferrous-oxalate, ferrous-citrate, or a mixture of both. It may also be varied by the use of a

restrainer, or of a smaller or larger excess of citric acid. The ferrous-citrate gives a warmer colour than the ferrous-oxalate; and a restrainer added either in the form of chloride of sodium (common salt), or free citric acid gives a still warmer tone, *the exposure being duly increased.*

In development, the plate should be touched by the fingers as little as possible, as chloride plates are far more liable to stain than bromide plates.

Lantern Slides.

Slides for what used at one time to be called the "magic lantern," but what is now commonly designated by the more imposing title of the "optical lantern," are simply transparencies made of a small size to suit the optical apparatus. The usual size is 3¼ inches square. If negatives be made of this size specially for the production of the slides, the matter is a very simple one. Gelatino-bromide plates *may* be used, but gelatino-chloride are very much better.* The printing is done by contact, and development is performed precisely as for a transparency, two points being, however, specially borne in mind: first, that the high lights be kept absolutely clear; second, that the shadows be made a little less dense than would be considered desirable for a transparency to be viewed direct. A slide is usually finished by placing a second piece of glass against the film side of it, and fixing the two together by black paper at the edges. "Needle" paper is the best.

The common size of lantern plate is, as has been said, 3¼ inches square, but the picture is of necessity somewhat smaller. The greatest length or breadth is 2⅞ inches. The amateur slide maker is cautioned against the abominable custom

* Collodio-bromide or "bath" collodion plates are still better, but it is beyond the scope of a book for beginners to enter into details of these processes.

of many professional slide makers, of making all slides uniformly square or circular. The actual picture, not the glass, is here referred to. It is very seldom that either a square or a circle is a suitable shape for a picture, and it is not often that the same relative length and breadth suits two different pictures. What, then, is to be expected if a uniform square or circular patch be taken out of the middle of all and sundry negatives? In every case the length or height of the picture should be kept $2\frac{7}{8}$ inches, but the breadth or width should be masked down to suit the particular subject, just as a print is trimmed.

One more warning about lantern slides. Slides are very often made from hand-camera negatives, and in the case of such negatives, more than in the case of any others, are vertical lines likely to lean to one side or the other, because the base of the camera has not been held level. Great care should be taken to have the edges of the slide not of necessity parallel with the edge of the plate, but parallel with any vertical lines there may be, or with the sea horizon, if there is one in the picture. I have often seen slides, that would otherwise have been excellent, utterly spoiled by giving the appearance of houses falling out of one side of the picture, or of a sea that was all up and down hill. It is extraordinary how many photographers, excellent in all other matters, will perpetrate this terrible blunder, both in prints and slides.

When a lantern slide—or, in fact, a transparency of any kind—has to be made to a reduced scale (smaller, that is, than the negative), the camera must be used either to produce direct a reduced transparency, or to produce a reduced negative, from which transparencies can be printed in the usual way. The method of reducing will be explained at the end of this chapter.

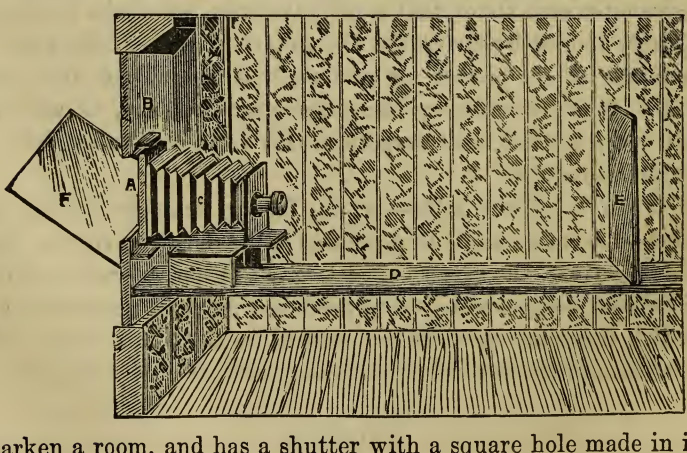
Enlarging.

The advantages of being able to make enlargements need not

be insisted upon; they are self-evident. The production of enlargements was, until within the last few years, a thing rarely undertaken by an amateur; but the introduction of gelatino-bromide paper for the purpose has made enlarging so simple an affair that there is no reason why any amateur should hesitate to undertake the work.

Special apppliances are made for producing enlargements. These are simply modified optical or "magic" lanterns; that is to say, they are lanterns in which a negative from which it is desired to take an enlargement takes the place of a lantern slide. A negative image is thrown and is received on an easel, on which is fixed a piece of white paper for focussing, afterwards the sensitive gelatino-bromide paper to receive the exposure. The paper is, after exposure, developed in the usual way.

The appliance mentioned is very convenient, but it is somewhat expensive, and, moreover, will not enlarge but from small negatives. In a camera and lens every photographer who can



darken a room, and has a shutter with a square hole made in it, has all the appliances necessary to produce enlargements of

practically any size from any negative his camera will make. I here illustrate the arrangement.

A is a hole cut in the shutter B, so that the back end of the camera C may lie against it, shutting out all light. D is a board so constructed that it can hold the camera and also an easel or upright board, which latter must be capable of adjustment so as to be approached to, or receded from, the camera.

It is not necessary that the easel should slide. An amateur, at any rate, never needs to enlarge to a mathematically correct extent, and, as a consequence, it is sufficient if the easel E can be fixed to the board at every three, or even at every six inches. In the writer's enlarging room this is managed with pegs in the lower edge of the easel, and holes every three inches along the board D.* There is also a support at the back of the easel to keep it steady. F is a reflector consisting of a board or other plane whitened in any way, and fixed at an angle of 45° or thereby with the horizontal. It must be of such a size that, when the camera is out of the way, an observer looking from the position occupied by the lens when the camera is in position, will not see its edges through the hole A.

If the dark slide of the camera be of the American pattern, in which both shutters can be withdrawn, the negative to be enlarged may be fixed in the slide, which, again, may be run into its groove in the camera. If the slides be of the English pattern, a special frame of wood that will hold the negative is made to take its place, or the ground glass may be taken out and the negative be put in its place. In direct enlarging the film of the negative must be placed to the *outside*. In any case, it will be found that an image of the negative will be thrown

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* Farther experience has proved the *convenience*, at least, of a sliding easel.

by the lens on to the easel E, and that the distance of the easel from the camera will determine the size. The farther away the easel, the larger the image. The nearer the easel, on the other hand, the smaller will be the image; but the longer will the camera have to open, till, when negative and image are of the same size, the camera will have to be opened twice as long as when a distant object is being photographed; and the distance between the negative and the image will be four times the equivalent focus of the lens.

The rule for the distance between the lens and the easel may be here given:—

n = the number of times of enlargement.
f = the equivalent focus.
d = the distance between the lens and the easel.

$$d = (n + 1) f$$

Example:—We wish to enlarge four times with a lens 10 inches diameter.

$$d = (4 + 1)\ 10 = 5 \times 10 = 50 \text{ inches.}$$

The distance from the negative to be enlarged from and the lens is got from the following formula; this distance being called d'.

$$d' = \left(\frac{n + 1}{n}\right) f$$

Taking the same example as before,

$$d' = (\tfrac{5}{4})\ 10 = 12{\cdot}5 \text{ inches.}$$

These examples mean, that with a lens 10 inches focus, when we wish to enlarge four times—that is to say, to make our picture four times as large *each way*—we will have to extend our camera to 12½ inches, whilst we make the distance from the lens to the easel 50 inches.

Those who can readily manipulate this very simple equation will find it a great assistance in getting their apparatus approximately into position. Those who cannot, may by the

expenditure of a little time, and the use of a foot rule, effect the same object by trial and error.

In any case, it is necessary to make a final focussing by the camera screw as usual, so as to get the image quite sharp. Any lens may be used, but probably the best is one of the rapid symmetrical or rapid rectilinear type. A stop is used only if necessary to improve marginal definition.

I hope I have made the optical arrangement sufficiently clear.

The next question is, as to what kind of a film is to receive the impression on the easel? Undoubtedly, the best thing for the beginner to use is the gelatino-bromide paper specially prepared for enlargements. This is worked exactly as described in Chapter XVIII.

After focussing, it is only necessary to shut out all white light by capping the lens, to pin the sensitive paper on to the easel—the dark-room lamp being used to work by—to make an exposure, and to develop, fix, &c., as for a contact print on gelatino-bromide paper.

Regarding time of exposure, it is most difficult even to give a hint, so many factors tend to vary it. It is best to pin a small piece of paper on to the easel first, and make a test exposure, when, after development, the fragmentary enlargement may serve as some guide.

It must be borne in mind that, *other things remaining the same*, the exposure varies as the square of the distance between the lens and the film, so that it is longer the more times we wish to enlarge.

The following may serve as a hint, although it may be taken as nothing more.

Enlarging three diameters from a good negative, light good, lens the rapid symmetrical, full aperture (aperture about $\frac{f}{9}$), the exposure required was thirty seconds.

I have seen beautiful results produced direct on "rapid"

paper, but the exposure needed is very much longer than for gelatino-bromide paper. It is certainly no exaggeration to say that it is two or three hundred times as long.

So much for the making of enlargements one at a time. If a particularly valuable picture be in the possession of the photographer, and he wish to make many enlarged copies from it, he will find the arrangement of taking them each one separately very tedious. He will find it necessary, or almost so, to make an *enlarged negative* from which to print in the ordinary way.

Put in the fewest words possible, an enlarged negative is got in one of two ways. (1) An enlarged *transparency* is made by aid of the camera, and from this a negative is taken by contact. (2) A transparency is made by contact, and from that an enlarged negative is taken by aid of the camera.

For various reasons, optical and others, the first method is the better. I shall therefore describe it.

The process, to begin with, is precisely the same as that described for enlarging on gelatino-bromide paper, but that a large gelatino-bromide plate takes the place of the paper. The exposure is made, as already described, and the plate is developed. The exposure must be long enough to impress all the details of the high-lights on the plate. Indeed, no part should remain absolutely transparent as for an ordinary transparency.

This plate once exposed, developed, fixed, &c., and dried, a negative is got by pressing a second plate against it, and exposing by a gas light. This last plate may be either a bromide or a chloride plate. Probably the latter will give somewhat the better result. This negative may be printed from in the ordinary way.

A word on the negative best for making enlargements from. It should be a well exposed one, clear in the shadows, and on

the whole tending to be *thin.* A negative that gives a hard print is next to useless for purposes of enlargement.

Reductions from Negatives.

The way of reducing negatives will almost be understood by this time. It is best, in reducing, to reverse the arrangement shown in the cut; to fix the negative from which the reduction is to be made in the hole, and to turn the camera round with the lens towards it. Indeed, this is the best course to pursue even in enlargements, when it is not wished to enlarge to a size greater than the dark slide will hold.

In making lantern slides, it is possible to get the transparency direct by placing a gelatino-chloride plate 3¼ inches by 3¼ inches in the slide, the negative being placed in the hole in the shutter. The exposure, however, will be considerable; probably, with a rapid landscape lens, full aperture, never less than about ten minutes.* If, therefore, it is wished to get many slides from one negative, it is best to produce a reduced negative. To do this a transparency is made by contact. This may be either on a bromide or a chloride plate; preferably the latter. As in the case of the enlargement, care is necessary to expose long enough to get out all the details in the lighter parts.

The transparency is now placed in the hole in the shutter, the camera is adjusted so that its image is 2⅛ inches in its longest direction, and exposure is made either on a bromide or a chloride plate. From the negative thus produced any number of slides may be made by contact.

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* Those who can work wet plates, or collodio-bromide plates, will find that they can get excellent results with *exposures far less than this.*

CHAPTER XXIV.

MANUFACTURE OF GELATINE EMULSION.

I EXPRESSED the opinion, when beginning these lessons, that the amateur will generally find it best to buy plates from a manufacturer. He will probably find it both cheaper and more satisfactory to do so than to make them himself, unless he has at his disposal considerable time, and has great patience and a happy temperament, which will enable him to bear frequent disappointment, when, after going through the tedious process of making an emulsion and coating the plates, he finds that the latter are, from some unknown cause, useless.

Nevertheless, I believe that the photographer who makes himself acquainted with the process of the manufacture of dry plates, and knows how to make an emulsion, will have a more thorough mastery of the working of them than those who have never made their own plates. There are some few who, for the love of the work, prefer to make their own emulsion.* These are the real enthusiasts, to whom we look to further our knowledge of photography, and with such the manufacture of plates pays, if it be only in the satisfaction they have in relying on themselves alone.

The subject of gelatine emulsions and plates is one on which volumes might be—and, in fact, have been—written, and here,

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* Alas ! *very* few now.

of course, the briefest instructions only can be given. If the photographer succeed with these, he may, with advantage, take up the study of the advanced works that have been written on the subject.

A formula and instructions whereby a slow emulsion of very high quality may be made are first given. The plates prepared from it are very well suited for landscape work, where great rapidity is no object. They will be found to need exposures from two to four times those given in the tables, pages 86 to 89. Afterwards instructions are given for the making of emulsions of the very highest degree of sensitiveness.

The principal piece of apparatus needed is a drying cupboard or box. This is illustrated and described in the next chapter.

The other apparatus necessary is as follows:—

A large slab of plate glass, marble, or smoothed slate, levelled accurately, so that the plates can be laid on it to set. The larger the slab the better, as more plates can be placed on it at once.

A piece of coarse canvas or "scrim," such as ladies do worsted work on—say two feet square.

Several glass beakers or jars for mixing solutions in. Jam pots are suitable, and are better than glass vessels, as the latter are very likely to be broken in the dark room. The best of all, however, are glazed earthenware pots, known as "shut-over" jars. These have lids with a lip that close light-tight, and are, therefore, most convenient for dark-room manipulations. Three or four holding half a pint, and two or three holding a pint, may with advantage be purchased. They, as well as various other stoneware vessels useful in photographic work, are to be had of Messrs. James Stiff and Sons, High Street, Lambeth, London, S.E.

An ordinary hair-sieve, say six or seven inches diameter.

A vessel of such a size and shape that the sieve may stand in

it, and that when it—the vessel—is full of water, the upper edge of the sieve will stand (say) an inch above the surface of the water.

A large glass filtering funnel.

Several hock bottles. These, from their deep red or orange colour, are useful for various parts of the work.

An ordinary saucepan.

A Bunsen ring burner, on which this may stand to boil.

The following solutions are made up, and each is mixed in one of the stoneware vessels:—

A.

Nitrate of silver	200 grains
Distilled water	3 ounces

B.

Bromide of potassium	160 grains
Nelson's No. 1 gelatine	40 grains
Distilled water	2½ ounces
A one per cent. mixture of hydrochloric acid water	200 minims

C.

Iodide of potassium	12 grains
Distilled water	½ ounce

D.

Hard gelatine, such as Heinrich's...	300 grains
Water	several ounces

B and D are allowed to stand till the gelatine is thoroughly soaked, as indicated by its being quite soft. All the water is now poured off D, and as much water as possible is squeezed out of the gelatine.

The pots containing A and B must now be placed in hot water till the solutions are at about 160° Fahr., when B is poured into one of the hock bottles.

From this time all must go on in a not too powerful red or yellow light.

A little of A is added to the solution already in the bottle, and the whole is shaken. Small additions of A are made, so that it is poured in five or six stages into B, the whole being shaken at each addition, and a very thorough agitation being given at the end.

C is added, and the solutions, now forming an emulsion, are again shaken.

The whole is poured into one of the stoneware pots. This is placed in the saucepan, the lid is placed on the latter, and the water brought as rapidly as possible to the boiling point. A loose cover of some sort should be placed over the vessel during this part of the process, if an otherwise open one has been used, to prevent condensed water from dropping off the lid of the saucepan into the emulsion. The emulsion is allowed to remain for twenty minutes in the boiling water.*

At the end of this time the gelatine D is placed among the emulsion, and the whole is stirred to mix it. The pot is then put in a cool and dark place to allow the emulsion to set. It will do so in from one to two hours on a moderately cool day; but it may be left for days if it be desired. This is the best period at which to break the process, which is somewhat lengthy to be gone through with at one time.

When the emulsion is set quite stiff, or as soon afterwards as it is wished to complete the process, it is taken from the vessel either with a silver spoon, a strip of glass, or with the hands. The sieve must meantime have been placed in its appropriate vessel full of water. The lump of emulsion is placed in the canvas, the whole is placed under water in the sieve, and the

* If the boiling be omitted, the gelatine D being added to the emulsion after a thorough shaking, lasting for from five to ten minutes, a *very* slow emulsion, giving plates excellent for transparencies, will result.

canvas is twisted up so as to cause the emulsion to pass through it in fine shreds into the water. This must now be washed for half-an-hour, either by allowing water to run into the sieve, or by frequently changing the water in the vessel, the granulated emulsion being meantime constantly stirred round, either by hand, or with a thick glass rod having a blunted end. The object of this washing is to get rid of the soluble nitrate and bromide, whilst the insoluble bromide and iodide of silver—the sensitive salts—remain in the emulsion. At the end of half-an-hour the sieve may be removed from the washing vessel, and be placed in any convenient position, with one side somewhat tipped up, so that all superfluous water will drain off. The draining should go on for at least half-an-hour.* At the end of that time the emulsion is finished, and only needs to be re-melted and filtered. I have found nothing better for this than several folds of fine cotton, such as pocket-handkerchiefs are made of.

Half-an-ounce of alcohol is now added, and the emulsion is ready to be used for coating the plates. The quantity will be about twelve or fourteen ounces. It may be kept in one of the hock bottles wrapped in brown paper.

For a rapid emulsion, the following formula may be taken :—

A.

Nitrate of silver	200 grains
Distilled water	3 ounces

B.

Bromide of potassium	165 grains
Nelson's No. 1 gelatine	30 ,,
Distilled water	2½ ounces

* A capital washer, consisting of a vessel for holding the sieve, with provision for admission and discharge of the water, so that it may (the emulsion once being introduced and the lid being closed) be used in daylight has been introduced by Mr. A. L. Henderson.

C.

Iodide of potassium	6 grains
Distilled water	½ ounce

D.

Hard gelatine, such as Heinrich's ...	250 grains
Water...	several ounces

One of the matters needing the nicest attention now comes to be done. This is to render the solution B the least bit acid. It must be only perceptibly acid. In fact, it is probable that absolute neutrality, were such attainable, would be the best condition. Alkalinity is dangerous to the quality of the emulsion. Too great acidity is detrimental to rapidity. Very often the salts are themselves acid. Occasionally they are alkaline. They must be carefully tested. The silver solution (A) should not change the colour of either blue or red litmus paper. The bromide solution (B) should slowly turn blue litmus slightly red. It should be rendered sufficiently acid to do so by the careful addition of very dilute hydrochloric acid. If the silver (A) solution be perceptibly, or the bromide solution (B) be more than only perceptibly acid, the excess of acidity may be neutralised by the addition of very dilute liquor ammonia.

The operations after this are the same as for the slow emulsion up to the time of boiling. It is usual, in giving instructions for the manufacture of a rapid emulsion, to say how long boiling should be continued; but there are such extraordinary differences of experience in the matter that I avoid such a course. Some operators gain sensitiveness in a half or third of the time that others take, apparently working under precisely similar conditions. I advise experimenters to have recourse to the colour test which I explain.

If, immediately after emulsification or the mixing of the chemicals, we take from the vessel, with a glass rod, a drop of

the emulsion, place it on a piece of clean glass, and look at a light, such as a candle or gas flame, through it, the glass being held somewhat near the eye, the flame will appear ruby, or, at any rate, orange. The emulsions are said to be "ruby" or "orange" by transmitted light. If we examine it after (say) ten minutes' boiling, there will appear a very distinct change of colour. There will be a more or less near approach to blue in the appearance of the flame, and the emulsion is said to be more or less nearly "blue by transmitted light."

In practice, the emulsion is stirred (say) every ten minutes during boiling, and a drop of it is examined as described. When the change from red to blue is quite complete, the emulsion will have reached a fair degree of sensitiveness. The exposure needed for plates coated with it will be as near as possible those given in the Tables, pages 86 and 89. The process may be pushed still further, however, until an emulsion giving plates that will need exposures of only one-half to one-third of these is got. If such be attempted, however, the very utmost care must be exerted at every turning, as this sensitive emulsion is most ticklish to work with. To make it, boiling is continued for a period altogether twice as long as that needed to bring about conversion of the bromide to the blue variety. In the writer's practice, it takes three-quarters of an hour or thereby, as a rule, to get the blue colour, and he has boiled for as long as three hours without spoiling the emulsion. After boiling is complete, the process is the same as for the slow emulsion.

CHAPTER XXV.

THE AMMONIA METHOD OF EMULSION MAKING.

I HAVE always rather avoided giving ammonia formulæ for emulsion making, because, although I have been able to get the highest degree of sensitiveness by this method, I have not in my own practice been able to find any means whereby I could be sure of producing an emulsion free from green fog. This introduction of the alkaline carbonates in place of ammonia in the developer has, however, made the appearance of green fog a matter of comparatively little importance. Even if the carbonates be not generally used, the photographer may make use of a carbonate developer when he finds that he has had the misfortune to get a batch of emulsion showing green fog in a marked degree.

The following formula has given excellent results:—

A1.—Nitrate of silver	50	grains
Water...	¼	ounce
A2.—Nitrate of silver, dry	150	grains
B.—Bromide of potassium	160	,,
Iodide of potassium	10	,,
Nelson's No. 1 gelatine	40	,,
Water...	4	ounces
C.—Hard gelatine (*dry*)	300	grains

The strongest ammonia is added drop by drop to A, or the stock solution of one part strong ammonia, one part water.

Darkening of the solution will immediately take place. The addition of the ammonia is continued with constant stirring, till the solution just becomes clear again, which will probably occur when about one dram of strong ammonia has been added. The clear solution now obtained is called ammonia-nitrate of silver.

When the gelatine in B is soft, the whole is heated till the solution reaches a temperature of 140° Fahr., and is placed in a large vessel of water of the same temperature (a chemical thermometer must be used in this process), when emulsification is performed by pouring A1 (*cold*) into B in three or four operations, with stirring after each, and afterwards adding A2 (dry), and vigorously stirring for some minutes.

The vessel of hot water in which the jar of emulsion is placed should be so large that the temperature will not fall very much in an hour or so. It is now merely a question of how long the emulsion is allowed to stand "ripening" to get any degree of sensitiveness that is wished. It is best to judge by the colour test, as described in the last chapter. If the "ripening" be stopped whilst there is still a little red in the colour, the plates will be slow plates suitable for landscape work. If time be given to allow the colour to change entirely to blue, the plates will be of fair rapidity, as rapid as any but the rapidest plates in the market. If twice to four times that time be allowed, they should be as rapid as any plates made.

It is not possible to say exactly how long the time taken will be, but, roughly speaking, a good landscape plate will be got by fifteen minutes' emulsification, a rapid plate by thirty minutes, and a very rapid plate by an hour.

Whenever it is judged that "ripening" has gone far enough, the gelatine C is added (dry); the whole is stirred till it is melted, and the jar of emulsion is placed in cold water till the emulsion has set. When it is set quite firm, it is ready to be

washed, as described in the last chapter, but many prefer to precipitate with alcohol.

To precipitate, the following is the procedure:—

For the quantity of emulsion given above, fourteen ounces of methylated spirit* are poured into a jar capable of holding at least thirty ounces. A glass rod is held in the left hand. The emulsion, in place of being allowed to set and being washed, is cooled only to about 100° Fahr. The jar containing it is taken in the right hand, and the emulsion is poured in a thin stream into the methylated spirit, whilst this latter is continuously stirred with a glass rod. As soon as the emulsion touches the methylated spirit, it is deprived of almost all its water, and falls down in a thick mass of a consistency somewhat resembling soft india-rubber. If the glass rod be properly manipulated, the whole of this sticky stuff will cling to it. The greater part is sure to, but it is well to dip the hand into the methylated spirit after all the emulsion has been poured into it, and to remove any that may be sticking to the bottom. This is added to the lump of emulsion on the point of the rod, when the lump is squeezed just as a sponge is squeezed till all the spirit possible is squeezed out of it. The size of the mass will now be surprisingly small—very little larger than a walnut. This mass is torn up with the fingers into pieces about the size of a pea, which are dropped on to a jar of clean water, where they remain for twenty-four hours, the water being changed several times. At the end of twenty-four hours the pieces of emulsion—which will have swelled very considerably—are placed in a small jar, water being poured over them to make the quantity up to eight

* The writer having now lived for several years in a country where *alcohol* of very fair strength and purity costs only a little over two shillings a gallon, has had no experience of the new English kerosene spirit, and cannot tell whether it may or may not be used for this process; but he thinks it unlikely that it may.

ounces. Heat is applied to melt the whole. Half an ounce of alcohol (*not methylated spirit*) is added, and the emulsion is ready to spread on glass.

In coating with this emulsion it is advisable to have it as cool as possible—not much over 100° Fahr. If it will not run on the plates as cold as this, these must be very slightly warmed before the coating operation begins. By the process just described, emulsions giving plates of a sensitiveness 25 on Warnerke's sensitometer, and at the same time giving clear shadows and ample density, have been produced many times in succession. This sensitiveness is very high, but it appears that such plates do not keep so well as those of more moderate rapidity. They are liable to show a slight fog after having been stored for a few months.

CHAPTER XXVI.

PREPARING GLASS: COATING IT.—DRYING AND PACKING PLATES.

To prepare plates for coating, it is necessary, if they have been used before, to remove the old films; and whether they have been used or not, to polish them on one side to receive the emulsion.

To remove old films, the plates are left to soak for at least twenty-four hours in a mixture of one part of hydrochloric acid to twenty parts of water. Any waste acid will do. The strength of the mixture is not important, so long as it is not too weak, and many acids will do as well as hydrochloric; the same acid bath will do for a long time.

After the plates have been the time specified in the dilute acid, the films may easily be removed by the use of warm water and a scrubbing brush. Whitening is the best material I know of to give such a polish to the glass that the emulsion will flow easily on it. A mixture of ordinary whitening and water to the consistency of a thick cream is made. This is thinly spread on one side of the glass with a cloth, all the plates to be cleaned being thus smeared, and placed against the wall or in racks to dry. When the whitening has dried on them, each plate is taken in the hand. The greater part of the composition is removed by a *very slightly* damped cloth, and the plate is rapidly

polished with a perfectly clean and dry one; a beautiful surface is by this means obtained. Care must be taken to remove all whitening from the edges of the plates.

There are several methods of coating plates in common use. The best for those who have the skill is the method used for coating with collodion, which I describe; but probably most of those who have not worked the wet process will find the plan which was used for some time by the writer, and which is also described, the most convenient. For the ordinary method, the apparatus necessary is as follows:—

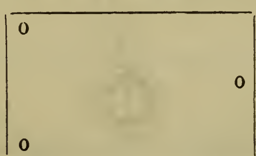
A small tea-pot. A large flat dish of the nature of a porcelain flat bath, to catch spillings. A pneumatic holder; this an india-rubber ball with sucker attached, the whole forming an apparatus whereby it is possible to pick up a plate.

In coating by the ordinary method, it is advisable to have two non-actinic lamps, one placed at the back of the operating table, the other in front of the operator, and above the level of his head. He can thus see the emulsion on the plate, both by reflected and transmitted light. The flat dish is placed between the lower light and the operator; the tea-pot, full of emulsion, melted, and at a temperature of 100° Fahr., or thereby, may be placed on this dish, and the plates, *polished side downwards*, are placed to the right of the flat dish.

The pneumatic holder is taken in the left hand, which is stretched across the flat dish, to take hold of a plate. The plate is held level, and a pool of emulsion is poured on to it, and guided over it exactly as was described for varnishing a plate in Chapter XIV., page 126. The only difference is, that more than half the area of the plate is at first covered with emulsion, and that, instead of the plate being drained, it is only slightly tipped up, so as to let a little of the emulsion return to the teapot. After this is done, the plate is gently rocked for

a few seconds, till we see by looking through it that the coating has spread evenly. To tell whether the plate has had enough emulsion left on it, we look through it, after it has set, at one of the non-actinic lights. If we can see the shape of the flame through the film, there is not enough emulsion on the plate.

The plates, as they are coated, are placed on the levelling-slab to set. Some emulsion is sure to be spilled into the flat dish. It is allowed to set, is then scraped up with a strip of glass, and is re-melted. For the method of coating, which is recommended to those not skilled in the wet process, the pneumatic holder is not needed. It is advisable, however, to make a small tripod. This is done by gluing three somewhat large-sized shot on to a quarter-plate in the form of a triangle, thus—

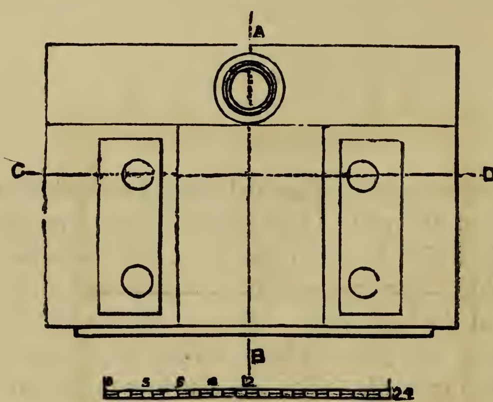


There is also needed a glass rod about two inches longer than the width of the plate to be coated, and a jam pot or glass measure in which to stand the rod. The dark-room lamp is placed within a few inches of the left-hand end of the levelling shelf, and at the back of it. There is, to the left of the lamp, room only for the pile of plates, which, in this case, have the polished side upwards. The rod standing in the jam pot is to the right of the lamp; the teapot with emulsion in it, as before, is in front of the lamp; and further forward still, near the front edge of the slab, is the small tripod mentioned.

A plate is taken from the pile and placed on the tripod. A pool of emulsion, about half covering the plate, is poured from the teapot. The glass rod is taken between the fingers and thumb of each hand, and dipped into the pool of emulsion right

across the plate. The emulsion will run between the rod and the plate to each edge of the latter. By a motion of the finger and thumb of each hand, the rod is lifted the smallest possible distance from the plate, and is rapidly moved first to one end, then to the other, the tips of the finger and thumb resting on the level table as a guide. This, if properly done, will cover the whole plate with emulsion; and if the plate is small—half-plate or under—it is sufficient to slide it to the far end of the table to set.

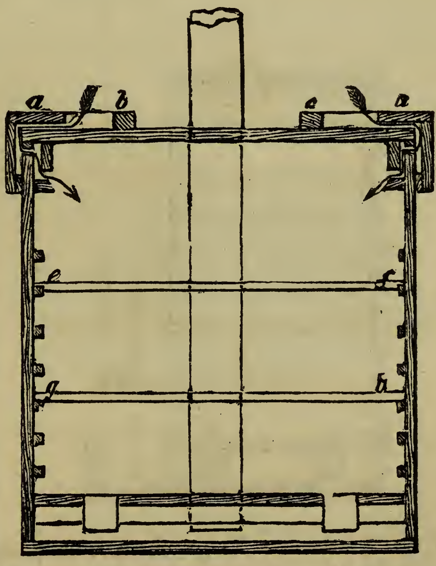
If the plate is large, the coating will not be evenly spread unless it is lifted, balanced on the tips of the fingers of the left hand, and rocked gently for a few seconds. By this method plates may, after a little practice, be coated with great rapidity.



As no excess is poured off the plate nor spilled in this method, it is possible, by using a very small teapot, to keep a constant check on the quantity of emulsion going on the plates. The covering power of the slow emulsion will be found somewhat greater than that of the rapid. With each ounce of the slow emulsion, about eight quarters or four half-plates may be coated; with the rapid, only about seven quarters or three halves.

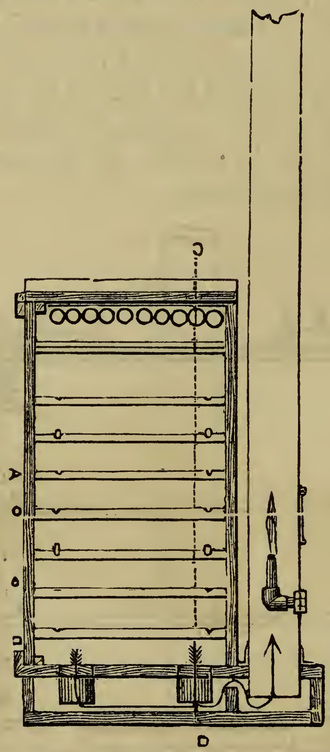
The films will "set" in a few minutes—that is to say, the emulsion will stiffen like a jelly—and will not run off the glass, whatever position the plate is placed in. They are now transferred to the drying-box. When dry, they are ready for use.

The drying-box calls for some description. There are various forms in use. They all have in view the inducing of a current of air among the plates, generally by the burning of a gas jet in a tube or chimney. The fault of most is that the air passages are far too contracted. In many, heat is applied to the incoming air. This is quite unnecessary, if the air passages are sufficiently large and well arranged, and if the box can be placed in a fairly dry place. It is, moreover, a mistake to use artificial heat in drying plates, if it can be avoided, as they are liable to be rendered distinctly slower thereby.



A form of box that has been used by the writer for several years, and has given complete satisfaction, is here illustrated.

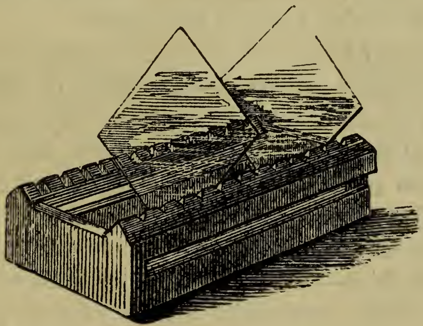
It will be seen that the air enters at the top of the box. It is drawn into an air chamber at its lower portion, and hence passes up the large tube with a gas flame burning in it. This tube should be carried either into the open air, or into a chimney. The plates are placed in racks, which were first designed by Mr. G. F. Williams. A sketch of one of these is given. Two plates may be placed back to back in each pair of



notches, if the size be small. The racks can be placed on the cross rods shown in the box, the height of which may be adjusted to suit various sized plates.

The plates will take from twelve to forty-eight hours to dry, according to circumstances. When dry, they may be used at once, or may be packed for use at any future time. No limit is as yet known to the time during which plates will keep if stored in perfectly dry, pure air. They are very readily destroyed, however, by damp, especially if accompanied by heat, gas fumes, &c.

Plates may be packed in any kind of opaque paper. They may be packed in sets of four and six. Every two plates are put face to face, and have a piece of tissue paper between them. This tissue paper must be of the best quality, and care must be taken that it is *quite* dry, otherwise it is likely to mark the plates. Three packets of four, or two of six, are then taken, and wrapped together in a thickness of opaque paper. Two wrappings of brown paper are then put around all, and the package may be handled in any light. For amateurs, who



never make a very large stock of plates, the best course is to use grooved light-tight boxes. Such made of wood are very expensive, but pasteboard boxes with paper-covered metal grooves, which are very handy, are made by Messrs. Arundel and Marshall, Penn Street Works, Hoxton, London.

CHAPTER XXVII.

ORTHOCHROMATIC OR ISOCHROMATIC PLATES.

It has been pointed out at the beginning of this book that the plates commonly used in photography are all but insensitive to the colours red and yellow. They are also but slightly sensitive to green, being, in fact, enormously more affected by the colours at the blue end of the spectrum than by any others. The result is that any objects of a red or yellow colour come out much too dark in working with ordinary plates, whilst green objects do so also, but to a less extent.

In photographing subjects that depend for their effect greatly on colour—especially paintings—the effect of this want of sensitiveness to certain colours has been very seriously felt, and for years attempts, more or less successful, have been made to produce plates more sensitive to the yellow and red rays, so as to render the colours with their true values. One of the great difficulties in landscape work—namely, the bad rendering of distances and skies—can be got over by the use of orthochromatic plates. Some commercial makers of such plates claim that great advantage results from using their plates for landscape work, even without the yellow screen. The writer has been able to find barely a perceptible difference in the results, in landscape work, of common plates and of orthochromatic, unless a yellow screen be used with the latter. Could a plate be produced that would give true orthochromatic effects without a

yellow screen, it would mean a revolution indeed in landscape work. Of late, the success has been very great, and ortho- or isochromatic plates, as they are called, are articles of commerce.

These plates are much more sensitive to the yellow, and sometimes to the red, than are ordinary plates, yet they do not give these colours with their true values unless the blues be somewhat suppressed; so that a somewhat long exposure can be given to thoroughly bring up the yellows and reds. This can readily be done by photographing through a piece of very light yellow glass, or—where it is possible, as in the case of a painting—by illuminating the subject with yellow light, such as daylight passed through very light yellow glass or paper, or unmodified gas or lamp-light. Still another method is to coat one of the surfaces of the lens to be used with a film of collodion stained slightly yellow.

The vendors of orthochromatic plates will provide yellow screens.

In working orthochromatic plates, it is necessary to use only the smallest quantity of deep red-coloured light, especially till the plate has been in the developer for some little time. After this it is less sensitive, but still great caution must be used.

As I have said, orthochromatic plates are now an article of commerce, and most amateurs will certainly rather buy than make them; but it is likely that any amateur who is enthusiastic enough to make his own plates will like to try "orthochromatising" also. I therefore give a description of the process. It is taken from a book that is the joint work of Mr. A. Pringle and the present writer.*

* "Processes of Pure Photography"; the Scovill and Adams Co., 423, Broome Street, New York.

"The substances most generally used for (achromatising) gelatine plates are eosine compounds, such as the dyes known as erythrosine, rose bengal, and eosine itself, and with these is generally used an alkali—viz., ammonia. The form in which these are generally used is generally that of a bath applied to the coated and dried plate. . . . Every precaution must be taken to guard against fog, as the plates are rendered not only highly sensitive to yellow and orange, but are also alkaline in reaction, in which state a plate is always highly susceptible to fog, not only from light, but from every sort of noxious vapour. The light used must be of the deepest ruby colour, and, indeed, the less even of that used the better. Certain dyes also fog plates even in darkness.

"A plate should be chosen with an emulsion containing little or no silver iodide.* We have known as little as three parts of iodide per centum of bromide to nullify our attempts to get a good orthochromatic effect.

"The plate is first bathed for two minutes in a solution :—

Liquor ammonia	1 part
Water	100 parts

"Then, without washing, immerse in :—

Dye (eosine 'B,' erythrosine, or rose bengal, &c.)	1 part
Water	10,000 parts
Ammonia	100 ,,

"The most convenient way to arrive at these very dilute

* The presence of iodide in the emulsion of a plate is indicated by the *yellow* colour of the film, if examined by reflected daylight, and a fair idea of the quantity of iodide present may be formed from the intensity of the yellow. I am of opinion that very few commercial plates contain as much as three per cent. of silver iodide in the emulsion.

solutions of the dye is as follows. Make first an aqueous solution of (say)—

Erythrosine ...	1 part	(1 gram, for instance)
Water ...	1,000 parts	(1,000 c.c., for instance)

"This may be kept a considerable time in the dark.

"The ordinary 10 per cent. ammonia solution may be used.

"Then take—

Dye (1 : 1,000)	1 part
Ammonia (10 per cent.)	1 ,,
Water	8 parts

"Some dyes useful for this purpose are insoluble in water; in these cases alcohol (absolute) may be used for the first solution:—

Dye (as cyanine)...	1 part	(1 gram, for instance)
Absolute alcohol...	1,000 parts	(1,000 c.c., for instance)

"Some workers find difficulty in using the alcoholic solutions, as there is a marked tendency to uneven staining of the plates.

"Mr. J. B. B. Wellington, of London, has shown a way to overcome the awkward precipitation that takes place when cyanine is dissolved in water.

"Prof. C. H. Bothamley, F.I.C., F.C.S., of Leeds, has done much to elucidate the practice and principles of this process; his writings may be found in files of the *Photographic News*, 1887, and elsewhere. We mention his name simply because it has been prominently brought forward lately, and not at all to the exclusion of others, as Vogel, Eder, Ives, Abney, Schumann, &c.

"Of all the processes tried by the writers, none seems to them more satisfactory—certainly none is more simple—than that last suggested by Mr. Ives, of Philadelphia. It may be stated thus:—

"In four ounces of absolute alcohol dissolve one grain of erythrosine or cyanine. Soak the gelatine bromide plate in this for a minute. Allow to dry. Wash for a short time in running water. Dry, and use. No alkali is used. The plates keep well. The cyanine renders the plates so very sensitive, even to red rays, that these operations, as well as development, must be conducted practically in darkness. The erythrosine formula has proved in our hands eminently satisfactory, the cyanine no less so, but the precautions necessary with it are apt to be irksome."

CHAPTER XXVIII.

CONCLUDING REMARKS.

I HAVE but little to say in conclusion. I have tried in this little book to give as clear and as practical instructions in the various manipulations connected with negative making and printing as possible. It must be understood, however, that few rules or instructions appertaining to photography are absolute; they are all varied by circumstances. All that can be done by written instructions is to guide the intelligence of the beginner. When he ceases to be a beginner, he should depend on his own intelligence and faculty of observation more than on any instructions.

Let the student not be discouraged by failure. Failures he certain to have. Even the most experienced fail occasionally, the majority more often than they are willing to allow; and if they do not always succeed, it is unreasonable for the tyro to expect to do so. Nevertheless, he should aim at perfection, and should not be satisfied till he reach it. Let him remember that, at least in landscape work, no amateur need despair of reaching the highest degree of perfection. Amateurs and professionals compete continually against each other, and the former as often as not carry off the palm.

The young photographer should, from the first, exercise his faculty for observation, and note the most minute departure from received rules. There are few departments of science in

which there is a wider field for investigation than in that of photography, and even an inexperienced photographer, if he observe closely, may add his mite to the mass of knowledge, which has been built up, for the most part, of such mites of observation freely given to "the brotherhood" by those who have made them. Often, a fact noticed by one comparatively inexperienced in photography may give the hint to a more experienced investigator, who may make good use of it.

Another thing to be impressed on photographers is that they should not fear to give others the benefit of their observations merely because it is possible that similar observations have been made before. It is sufficient that a fact is not generally known or appreciated to justify its publication, and the oftener it is published until it is appreciated, the better.

I have before remarked that if the beginner can get the help of a photographic friend, he will find his first labours much lightened. Let me now urge upon him that, whenever he begins to feel his way, he join, if possible, one of the numerous photographic societies there are in this country. Let him not suppose that he will meet with ridicule or contempt on account of his comparative ignorance. The writer was for some time deterred from joining a photographic society for such a reason; but on attending the first meeting all his fears were dissipated. The terrible "professional" whom he had dreaded to meet, he found to be a most kindly individual, willing—nay, apparently anxious—to give what aid he could to anyone who asked advice or assistance from him. In this respect I believe photographers are different from, and superior to, most other professional men. An amateur architect, engineer, or doctor, would by no means meet with the same kindly reception from professionals, at the gatherings of their societies, that the amateur photographer does at the gatherings of societies composed chiefly of professional photographers.

Finally, I repeat the advice that the reader, while he is still unfamiliar with the various manipulations, follow to the letter the instructions contained here, or wherever else he seeks for information; but that when he begins to feel his way he trusts to his own intelligence as his great guide. If he do this, I feel sure that, from the time he first succeeds in producing by development *something* on his plate, till the time when he has arrived at such perfection that he need not hesitate to hang his pictures on the walls at photographic exhibitions side by side with those of the first photographers of the day, he will feel that every step that he makes in advance is a triumph, and will find his work—or play, as he likes to consider it—a more absorbing and delightful one than almost any other that he could have taken up.

Let him bear in mind that every operation in photography is but a means to an end (the end being the picture), and that any means that conduces to the end is permissible. Let him remember, whatever may be said to the contrary, that photography is a fine art, or, at least, is capable of being such in the hands of those who have sufficient art feeling in them. It is too common a thing to hear painting compared with photography—of course to the discredit of the latter. This is not right. The two are, in reality, not comparable; they are different in purpose and in essence. Nevertheless, photography is — silently and slowly, perhaps, yet surely — influencing painting. It is teaching painters the great lesson that without truth there can be no true art. In what I now say, do not let me be misunderstood. I do not mean to say that unless some object be rendered with strict accuracy there is no art; but I mean this, that unless an object—say a tree or a man—is represented as it is *possible* for this object to be, then just in as much as it departs from this possibility it departs from true art. If a man or a horse be represented in a position that no man or

horse ever was in, will be in, or could be in, then this is wrong. If a house is shown as it could not stand, or a mountain as no mountain could exist, it is wrong. In this matter painters—let them admit it or not—are being educated by photographers.

We now seldom see, even by second-rate artists, portraits of men and women showing proportions between feet, hands, head, and body, such as never were; but we have only to look at portraits of fifty years ago (sometimes by eminent artists) to see that at that time things were different—that almost every man was represented as a monstrosity. In landscape painting the influence of photography is, perhaps, not so great, but it is there, and will continue to make itself more and more felt.

On the other hand, one of the highest phases of art is that which selects or combines, which, without representing a scene exactly as it is, is careful to show it as it *might* be. The power of thus selecting and combining is one that photography possesses in but a limited degree.

I would fain, to the best of my poor ability, carry the reader on to more advanced branches of the photographic art; I would with pleasure instruct him in various methods of producing permanent prints, besides the one that has been described, and in the delicate manipulation of combination printing from two or more negatives, and in the thousand and one various ways in which the end—a picture—may be produced from the photographic beginning—a negative; but all this is without my limits, and I recommend those who wish to go deeply into the matter to read diligently any of the several excellent and complete manuals and text-books on photography that exist.

I hope and almost believe that I have filled a little gap in photographic literature—that I have produced the first set of instructions for working modern dry plates that pre-supposed no knowledge of any other photographic process.

English Weights and Measures.

APOTHECARIES' WEIGHT.

FLUID.

60 minims	=	1 fluid dram.
8 drams	=	1 ounce.
20 ounces	=	1 pint.

SOLID MEASURE.

20 grains	=	1 scruple	=	20 grains.	
3 scruples	=	1 dram	=	60	,,
8 drams	=	1 ounce	=	480	,,
12 ounces	=	1 pound			

The above weights are used by photographers. Chemicals are sold by—

AVOIRDUPOIS WEIGHT.

$27\frac{1}{3}$ grains	=	1 dram	=	$27\frac{1}{3}$ grains.	
16 drams	=	1 ounce	=	$437\frac{1}{2}$	,,
16 ounces	=	1 pound	=	7000	,,

French Weights and Measures.

The unit of liquid measures is a cubic centimetre, "c.c.," which measures 16·896 minims, and weighs 15·4 grains, or 1 gramme—the unit of solid measures.

1	cubic centimetre	=	17 minims (nearly).
$3\frac{1}{2}$	,, ,,	=	1 dram.
$28\frac{2}{5}$	,, ,,	=	1 ounce.
100	,, ,,	=	3 ounces, 4 drams, 9 minims
1000 ,, or 1 litre	,,	=	35 ounces, 1 dram, 36 minims.

As a gramme is equal to 15·4323 grains, in order to convert grammes into grains, multiply the former by $15\frac{1}{2}$.

Mems.—1 minim equals 1 drop; 1 drachm, 1 teaspoonful; 2 drachms, 1 dessert spoonful; 4 drachms, 1 table spoonful. A halfpenny and threepenny piece weigh $\frac{1}{4}$ ounce; florin and sixpence, $\frac{1}{2}$ ounce; 3 pennies, 1 ounce; 4 half-crowns and 1 shilling, 2 ounces; 4 half-crowns 4 florins and 2 pennies, 4 ounces. A halfpenny equals 1 inch in diameter.

DR. JANEWAY'S TABLE OF THE SOLUBILITIES OF PHOTOGRAPHIC CHEMICALS.

MADE FOR THE SOCIETY OF AMATEUR PHOTOGRAPHERS OF NEW YORK.

Abbreviations.—s. soluble; ins. insoluble; sp. sparingly; m. moderately; v. very; alm. almost; dec. decomposed.

CHEMICALS.	WATER.		COLD ALCOHOL.
	59° F.	212° F.	
One part is soluble in	Parts.	Parts.	
Acid, Citric	0·75	·6	v. s.
Gallic	100	3	m. s.
Oxalic	8	1	v. s.
Pyrogallic	3·5	v. s.	v. s.
Tannic	6	v. s.	v. s.
Alum	10·5	v. s.	ins.
Chrome	10	dec.	ins.
Ammonium, Nitrate	0·5	v. s.	v. s.
Chloride	3	v. s.	sp. s.
Carbonate	4	dec.	m. s.
Sulphocyanate	v. s.	v. s.	v. s.
Bromide	1·5	0·7	sp. s.
Iodide	1	0·5	m. s.
Baryta, Nitrate	8	3	
Cadmium, Bromide	v. s.	v. s.	m. s.
Iodide	v. s.	v. s.	v. s.
Copper, Acetate	15	5	sp. s.
Sulphate	2·6	0·5	ins.
Gold, Chloride	v. s.	v. s.	v. s.
Gold and Sodium Chloride	v. s.	v. s.	m. s.
Iron, Perchloride	v. s.	v. s.	v. s.
Protosulphate	1·8	0·3	ins.
and Ammonia sulphate	3	0·8	ins.
Iodide (Ferrous)	v. s.	v. s.	sp. s.
Iodine	7000		m. s.
Kaolin	ins.	ins.	ins.
Lead, Acetate	1·8	0·5	m. s.
Chloride	v. sp.	33	ins.
Nitrate	2	0·8	ins.
Lithium, Bromide	v. s.	v. s.	m. s.
Iodide	v. s.	v. s.	m. s.
Magnesia, Nitrate	v. s.	v. s.	m. s.
Mercury, Bichloride	16	2	v. s.
Cyanide	12·8	3	ins.
Potassium, Acetate	0·4	v. s.	v. s.

CHEMICALS.	WATER.		COLD ALCOHOL.
	59° F.	212° F.	
One part is soluble in	Parts.	Parts.	
Potassium, Bicarbonate	3·2	dec.	ins.
Bichromate	10	1·5	ins.
Bromide	1·6	1	sp. s.
Carbonate	1	0·7	ins.
Cyanide	2	1	m. s.
Ferricyanide	3·8	2	ins.
Ferrocyanide	4	2	ins.
Nitrate	4	0·4	ins.
Iodide	0·8	0·5	m. s.
Oxalate	3	v. s.	ins.
Permanganate	20	3	ins.
Sulphate	9	4	ins.
Sulphite	4	5	sp. s.
Sulphuret	2	1	sp. s.
Silver, Nitrate	0·8	0·4	m. s.
Oxide	v. sp. s.	v. sp. s	ins.
Sodium, Acetate	3	1	m. s.
Bromide	1·2	0·5	m. s.
Bicarbonate	12	dec.	ins.
Carbonate	1·6	0·25	ins.
Citrate	v. s.	v. s.	sp. s.
Hyposulphite	1	v. s.	ins.
Iodide	0·6	0·3	m. s.
Nitrate	1·3	0·6	sp. s.
Phosphate	6	2	ins.
Pyrophosphate	12	1·1	ins.
Sulphite	4	0 9	sp. s.
Sulphate	2·8	0·4	ins.
Tungstate	4·0	2 0	ins.
Strontia, Chloride	1·88	v. s.	sp. s.
Uranium, Nitrate	v. s.	v. s.	m. s.
Zinc, Iodide	v. s.	v. s.	m. s.
Bromide	v. s.	v. s.	m. s.
Chloride	0·33	v. s.	v. s.

INDEX.

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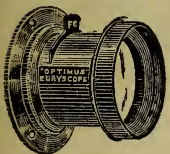
Trade # ‘OPTIMUS’ *Mark.*

IRIS DIAPHRAGMS FITTED TO RAPID EURYSCOPE AND RAPID RECTILINEAR.

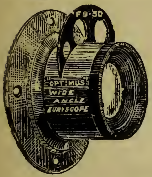
5×4	7×5	9×7	10×8	12×10	15×12	18×16
10/-	11/-	12/6	14/-	16/-	18/-	20/- extra.



‘OPTIMUS’ RAPID EURYSCOPE LENS.

The aperture is F/6. The Lenses are of Special Optical Glass, constructed with the nicest precision of curvatures, so maintaining good marginal definition, coupled with the most extreme rapidity.

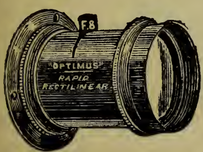
5×4	6×5	7×5	8×5	9×7	10×8	12×10	15×12
63/-	78/-	94/6	110/-	126/-	220/-	380/-	580/-



‘OPTIMUS’ WIDE-ANGLE EURYSCOPE LENS.

F/9·50. This aperture is exceedingly open for wide-angle work. The definition, however, is in no way sacrificed, as the curvatures are most perfectly accurate, and the minute detail in architectural and interior subjects is rendered with the maximum of crispness and a total absence of distortion.

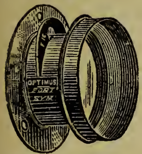
To cover..................	5×4	7×5	9×7	10×8	12×10
Equiv. Focus, inches	3¼	4¾	6	8	12
Price	63/-	94/6	126/-	220/-	380/-



‘OPTIMUS’ RAPID RECTILINEAR LENS.

Aperture F/8. Second only to the above for Rapidity, therefore well suited for instantaneous effects, outdoor groups and views, as well as interiors. Copying and enlarging are also within the capabilities of this lens—in fact, its work may be styled UNIVERSAL.

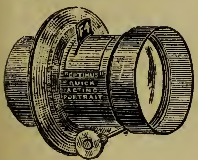
5×4	6×5	7×5	8×5	9×7	10×8	12×10	15×12	18×16
36/-	50/-	56/-	70/-	90/-	142/-	180/-	225/-	275/-



‘OPTIMUS’ WIDE-ANGLE SYMMETRICAL LENS.

Aperture F/16. Specially adapted for Architecture. Can be used to advantage when very close to the subject.

5×4	7×5	9×7	10×8	12×10	15×12	18×16
42/-	58/-	90/-	142/-	180/-	225/-	275/-



‘OPTIMUS’ QUICK-ACTING PORTRAIT LENS.

Aperture F/4. Specially constructed for short exposures in Portraiture. They are second to none, definition being maintained by their perfect optical qualities.

4½in. Focus,	Carte-de-Visite,	1 B,	diameter	2in. ...	90/-
5¾in. ,,	Cabinet	2 B,	,,	2¾in. ...	120/-
9in. ,,	Grand Cabinet,	3 B,	,,	3½in. ...	180/-

‘OPTIMUS’ STEREOSCOPIC LENSES.

Sold in pairs, accuratefy matched. Giving brilliant definition, and covering 3¼ by 3¼ perfectly.

Rapid Rectilinear Aperture F/8 ... ... per pair 80/-
,, Euryscope ,, F/6 ... ... ,, 120/-

The above are recommended for either Stereoscopic Slides or Photographic Transparencies for Magic Lantern Projection; being of short focus and fairly wide angle, they include a very comprehensive amount of field. The optical arrangement is such that the resulting pictures will bear almost unlimited enlargement.

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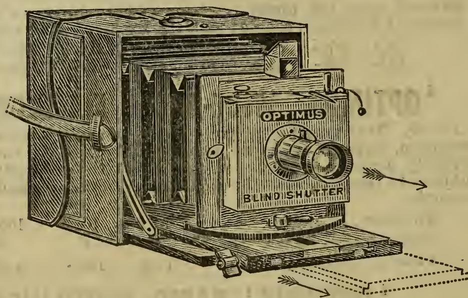

"OPTIMUS" CAMERA DE LUXE

FOR THE

HAND OR STAND.

Possesses Extra Long Focussing Adjustment.

This Camera has the advantage of being very light indeed, and very small indeed. Including the Double Dark Slides, its weight is but 2½lbs., whilst its dimensions, including Black Morocco Leather Covering, are only 6¼ by 5½ by 5½. The Telescopic Base-board sufficiently expands the bellows to allow the use of a lens of 11½ inches focus. The focussing is by Rack-and-Pinion arrangement. A Finder is also provided for instantaneous snap-shots. A Swing-Back arrangement and a Roller-Blind Shutter, giving Exposures of varying speeds, are affixed. The Lens (Extra Rapid Euryscope) is attached inside the front, so that the closing up and opening out of the Camera is an operation of only one second. For either out or indoor use it is a comprehensive and self-contained little machine.

Price, including Three Dark Slides, Roller-Blind Shutter, and "Optimus" Extra Rapid Euryscope, mounted in Aluminium, with Iris Diaphragm,

For Plates	Dimensions of Camera when closed.	Price.	Ex. Dark Slides.
4¼ by 3¼	6¼ by 5¼ by 5¾	£10 10 0 ...	14 6
„ 4	7 „ 5½ „ 6	12 12 0 ...	14 0
6½ „ 4¾	9 „ 6¾ „ 8	15 15 0 ...	15 0